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THE FOUNDRY

VOL. 13. DETROIT, MICH., SEPTEMBER, 1898. No. 73.

An Oven for Dry Sand Molds.

BY I. B. THOMAS.

Some time ago we found our foundry department was running very much behind, owing to lack of proper drying facilities, in their orders for a class of work which was required to be made in dry sand molds, and in consequence, it was necessary for us to increase our oven capacity to meet the demands.

After much careful study on the subject, we decided to build a pair of down-draught ovens much after the idea as outlined by Mr. W. L. Hayden, in THE FOUNDRY for March, 1897, in his article "A Down Draught Core Oven."

Figure 1 is a general plan of our oven, figure 2 and figure 3 cross and transverse section respectively, while figure 4 is a front elevation.

Our class of work to be dried was more or less standard (locomotive cylinders) and ranged in weight from 3,500 lbs. to about 8,000 lbs. With these conditions, and no very great variation in the height of our flasks likely, we were able to make our oven comparatively low (8 feet), the advantage being that there was a smaller volume of air to be maintained at the desired temperature. With the flue arrangements hereafter described, we considered it perfectly feasible to allow the molds to reach within a few inches of the ceiling of the oven without either burning the top or else failing to dry the bottoms of the molds. With the common form of ovens, having one or more fireplaces along the sides or at the end, and a single flue at some opposite point and seldom in the floor as it should be, this is not possible, and as a consequence, you find not more than half the volume of the oven occupied and complaints that "we couldn't get enough cores dried."

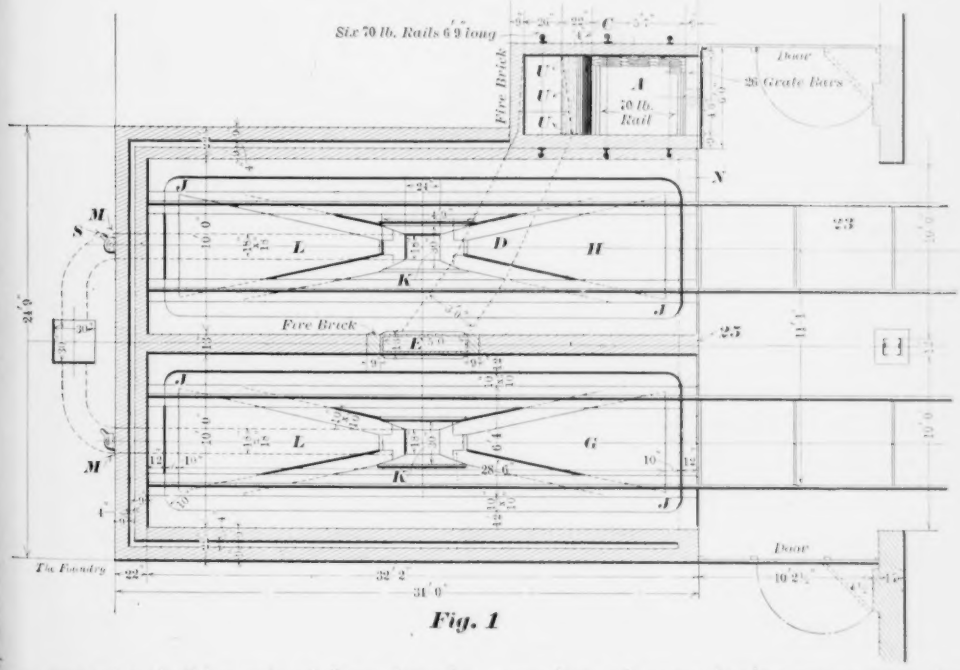

Fig. 1

Experience with both designs of draught has proven this fact very conclusively, and when forcing our new oven very hard, we have been able to set pieces of pine boards

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on fire while lying directly on the floor. With the excellent arrangements and facilities for regulating the draught, we find very little difference in the temperature of the various parts of the ovens, and with the asbestos-lined doors, shown in detail in figure 7, the front of the oven is as hot as any other portion. As a consequence, our molds are quickly and uniformly dried.

(H) and (G), figures 1 and 2, 32 feet 2 inches long by 10 feet wide and 8 feet high, each capable of holding two of our core trucks with two complete flasks on each, or a total capacity of eight molds. Both ovens are heated by the same furnaces, (A) figures 1 to 4, and the grate, 4 feet 6 inches by 5 feet 7 inches, gives ample area with a light coke fire to maintain a uniform temperature of 475 degrees F., as indicated by a Brown Hot Blast Pyrometer located at (25) figures 1 and 4. The stem of this pyrometer runs downward at an angle of 45 degrees, to an opening in the partition between the two ovens about midway in height. This in-

Fig. 2

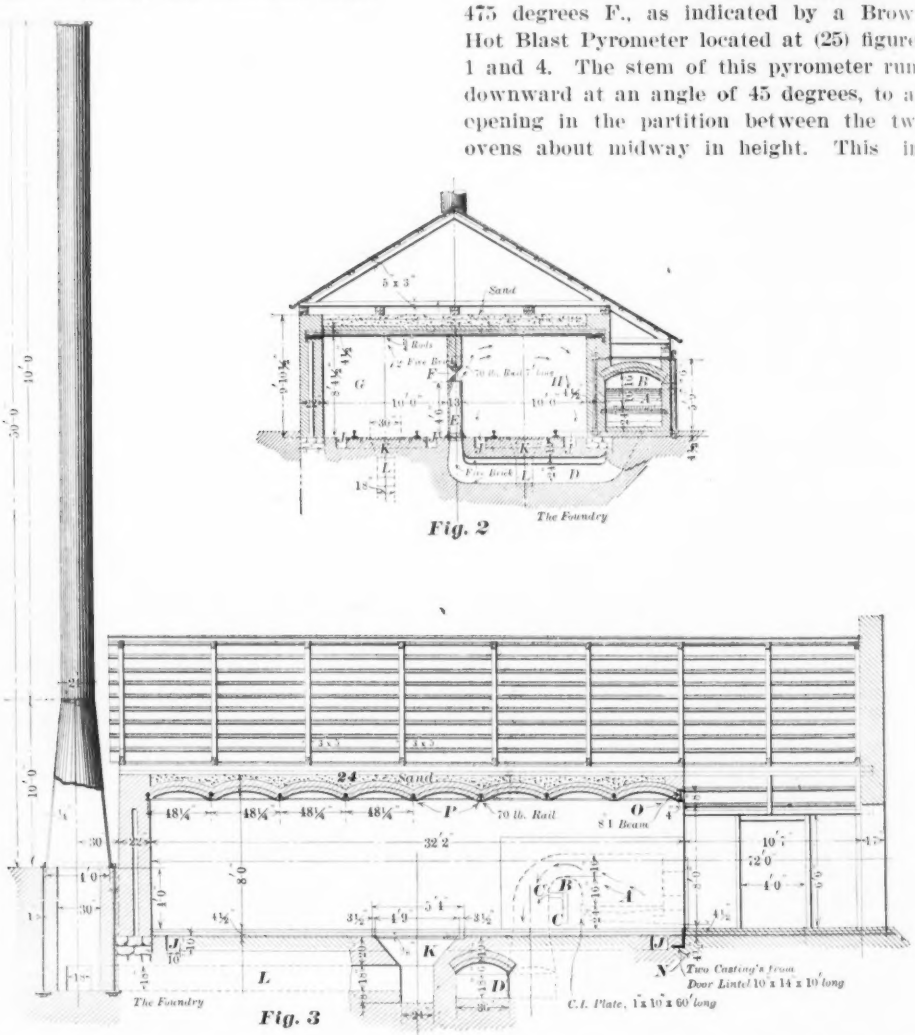

Fig. 3

As floor space inside our foundry was very valuable, we built the oven entirely on the outside, and are rather surprised that this is not done more frequently, both on account of room and the necessarily disagreeable presence of heat and gases whenever the doors are opened.

By reference to figures 1 to 4 you will notice that we really have a pair of ovens

strument soon pays for itself by the cores or molds which are otherwise sure to be burned even by a reliable fireman.

After leaving the grate (A) figures 1 to 3, the hot gases pass over the fire brick arch (B) where they unite with cold air drawn in through the openings (C) from the outside, the idea being to pass as much air through the ovens as possible, in order to

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carry away the moisture from the molds. From here they pass downward through the fire-brick lined flue (D) under the oven (H) and up to the box (E), 5 feet by 12 inches, inside measurement, and built in the partition wall of the two ovens midway of its length. This box is shown in detail in figure 6. Thence they pass out the openings about 3 feet from the roof on either side of the box (E) and naturally spread themselves along the ceilings of the ovens.

At (F) figure 2, is shown a damper set to throw all the gases into the oven (H) so that oven (G) would be entirely out of service, in which case the damper (M) on this side would be closed, giving the full benefit of the stack draught to the one oven. Ordinarily the damper (F) hangs perpendicularly, and both dampers (M) are kept wide open, thus allowing an equal circulation in both ovens.

Referring to figure 6, we see that box (E) is made of one-half inch boiler steel (this being used on the sides in preference to a brick flue to economize space between the ovens), riveted to 2 inch angle irons at the four corners and supported on the floor by a 2½ inch angle iron on all four sides. The damper (F) is swung on hinges by the rod (V) and adjusted by means of the handle (Q) built in the wall and locked by the hand nut (R). The top of this box was made V-shape to allow a full opening on either side and the free upward passage of the gases. A piece of old 70-lb. rail, figure 2, helps support the brick-work above. Notwithstanding the high heat this box is subjected to, it has shown no signs of warping, and the damper can be adjusted as readily as when first fitted up eight months ago.

Figure 21 shows the details of dampers (M M) figure 1. These consist of a 2 inch by one-half inch wrought iron frame (T) figure 21, the inside dimensions being slightly smaller than those of the flue (L), figures 1, 2, and 3, into which it is built. A three-eighth inch steel plate (M) figure 21, riveted to a 1 inch rod, forms the damper proper. This rod is carried to the surface of the ground through a piece of 1½ inch pipe, where by means of the handle (S) it is readily regulated and without the necessity of entering the ovens.

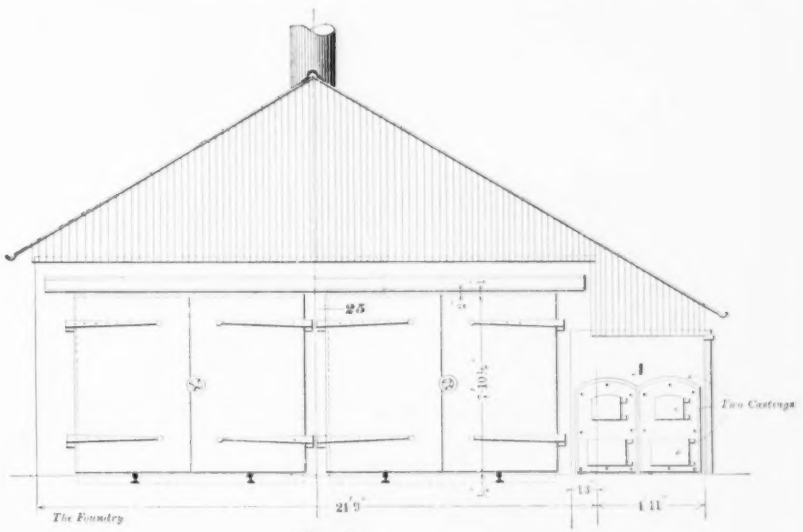

Fig. 4

Figures 2 and 3 show the construction of the roof, which consists of eight arches 9 inches thick, with a rise of 6 inches in 4 feet. As we had considerable old rail on hand, these were used (see "P," figures 2 and 14) as supports for the arches, except in the case of the front one (O), figures 2 and 26, where an "I" beam was required for finish. These were tied together by the three-quarter inch rods, figure 12.

In order to tie the side and partition walls together, angle plates were riveted on the bottom at either end and middle of the rails, figure 14, and the "I" beam, figure 23, and in this latter figure you will notice two 2 inch angle irons (27) to form a stop and seal for the top of the doors. The cast

iron door lintel (N), figures 1, 2 and 16, answers very well for the bottom stop by allowing it to project about an inch above the rails. It also forms a retainer for the asphalt brick floor outside the ovens, as the floor inside is level with the base of the rails. The space between the rails of each track outside and extending into the main foundry is made flush with the rail heads by means of cast-iron plates (23) figure 1, shaped to clear the wheel flanges.

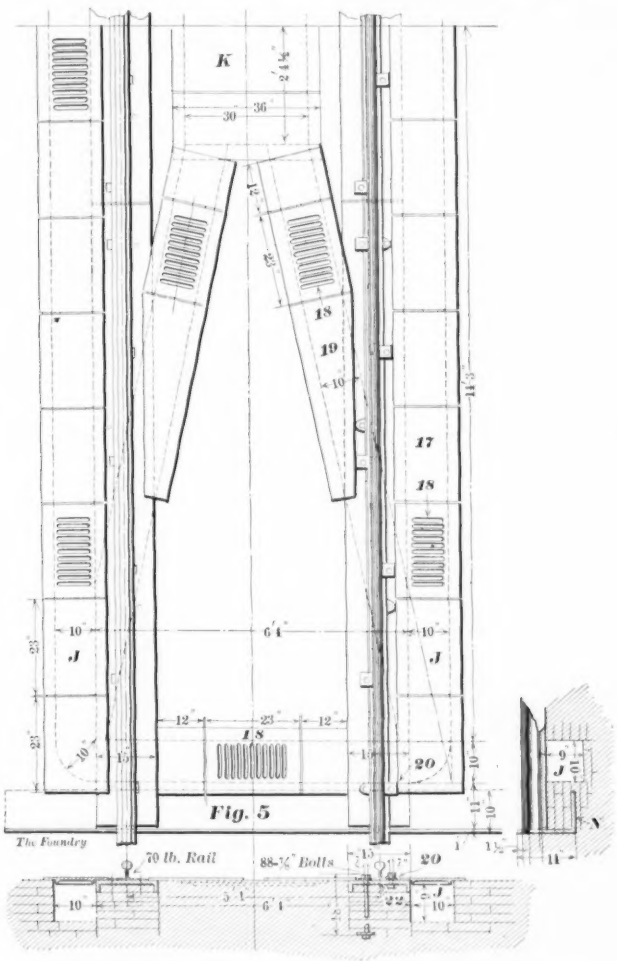

Fig. 5

Figures 1, 2 and 3 show the general arrangements for obtaining a draught in all parts of the oven and proportioned so that the temperature will be uniform. All the gases must pass downward from the ceiling to the flues (J J). Figure 5 is a half plan of the floor arrangements and sections showing the flues (J) and the lower door stop (N). By an inspection of this figure you will see that all the flues are covered with five-eighth inch cast-iron plates, shown in detail in figures 17 and 19, except at twelve points where the cast-iron gratings (figure 18) replace the plain plates and form the opening into which the gases are drawn by the stack draught. You will notice that the arrangement is perfectly symmetrical with respect to the central pit (K), figures 1, 2, 3, and 5, from which leads the flue (L) to the stack base. In this way there is a uniform draught in each of the four corners of the oven, and as the grating plates (18) and the plain ones (17) are interchangeable, it is possible to increase or decrease the amount of draught, and consequently the temperature, at any part of the ovens. Figure 8 shows a detail of the construction of the stack.

The track is a much-neglected feature of

most ovens and consequently a continuous source of annoyance and often serious trouble, owing to depressions, causing drops in the molds when green, by the jarring, or else a core truck goes off the track due to the rails spreading. Tracks made by grooves in cast-iron plates are very unsatisfactory, as they will warp. We laid a brick wall or foundation 13 inches wide and 18 inches deep under each rail, and on this fastened cast-iron coping plates, figures 5 and 22, about 12 feet 6 inches long, and securely fastened with seven-eighth inch anchor bolts, coming through the holes in the four bosses (W) figure 22. These are staggered, and the bosses prevent any possibility of the rails spreading. Small T head bolts (figure 20) dropped in the rectangular openings (X) of the coping plates and turned serve to draw the clamps, figure 20, down on the rail bases. While this appears to be an expensive form of track, we believe it will pay, as it is permanent, and will give us no further trouble. The core carriages, which have roller bearings, run on it perfectly without the slightest jar.

We gave these tracks a downward slope of about 1 in 300 from the crane in the foundry, and with this slight grade the loaded trucks can be started by one man and then have to be held back to prevent running away. They are drawn out by a rope attached to the crane and running through a block in the center of the track.

Another feature to which especial attention was given was to prevent all possible loss of heat by radiation, and for this purpose all the external walls were made double 9 inches with a four inch air space between, figures 1 2 and 3. Of course, these walls are tied together every 3 feet or 4 feet by means of headers. The top was taken care of by covering the arches with 5 or 6 inches of old floor sand and in this way a wooden roof can be put on with perfect safety.

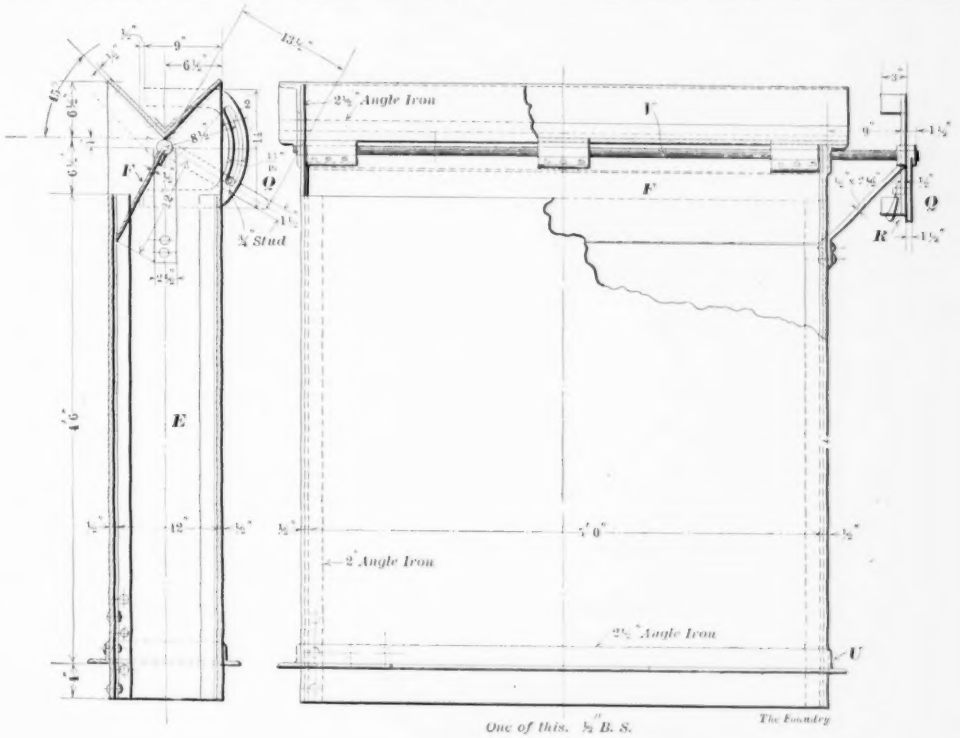

Fig. 6.

We now come to the doors, and from the dimensions of the external wall surface of the ovens, 20 feet by 32 feet, you see that they form about one-fifth of this radiating surface, a very important factor; and we wish to call particular attention to their construction as they retain the heat, and do not warp, thus allowing us to keep tight joints all around them.

Figure 7 shows a general plan, side and end views, and by reference to this and

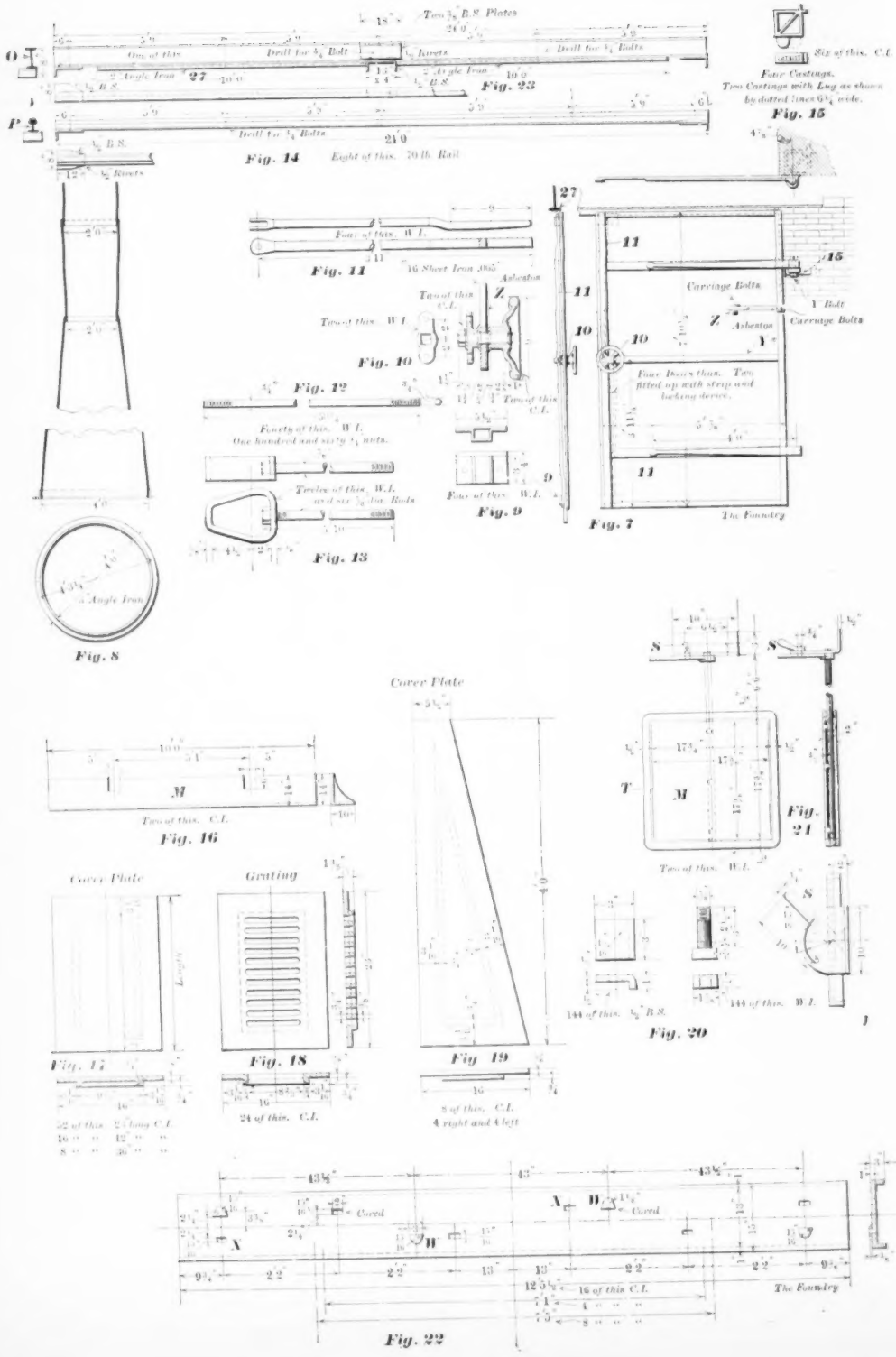
Fig. 14
Fig. 23
Fig. 15
Six of this. C.I.
Four Castings.
Two Castings with Lug as shown by dotted lines 6¾ wide.
Fig. 11
Fig. 10
Fig. 12
Fig. 13
Fig. 9
Fig. 7
The Foundry
Fig. 8
Fig. 16
Two of this. C.I.
Cover Plate
Fig. 21
Two of this. W.I.
Fig. 20
Grating
Fig. 17
Fig. 18
Fig. 19
Fig. 22
The Foundry

figure 10 we see that they consist of a main sheet (Z) of one-eighth inch iron, stiffened securely by a 2 inch by one-half inch flat iron frame and three 3 inch by one-half inch cross strips (V), all securely riveted to this sheet. Heavy wrought-iron hinges are bolted to the upper and lower cross strips, and these are hung on the cast-iron blocks, figure 15.

Sheet asbestos one-half inch thick covers the entire inner side of this door, and this is held in position and protected by two sheets of No. 16 iron, which lap in the center, and are held in place by three-eighth inch carriage bolts. These pass through enlarged holes in the inner sheet to permit free expansion and thus overcome the tendency of the whole door to warp. Figure 10 shows a detail of the hand wheel and double lever operating the bolts, figure 11. These latter pass through the boxes, figure 9, and engaged with the two inch angle iron (27) figure 14, at the top, and the plate (X) figures 1, 3 and 16, at the bottom. We consider these doors the best we have ever seen for the purpose.

When first fired up, we experienced a great deal of trouble obtaining any draught at the grate, and tried building fires in the ovens, hoping to start it and dry out the walls and flues. We finally were compelled to place a small steam jet near the base of stack as a blower. After using this for three or four days, or until everything was thoroughly free from dampness and well warmed up, we abandoned it entirely, and have never had the slightest lack of draught since. A very light coke fire is ample.

As we were using a number of oil furnaces of various types in our smithshop to quite an advantage, we tried the experiment of firing this oven with oil, hoping to find it more economical, but were much disappointed, as you can readily see by the figures below.

A careful record for four weeks showed that we burned an average of 1,455 lbs. of coke each 24 hours, and that it required five (5) hours' labor to wheel this in, fire and remove the ashes. A ten (10) days' trial of oil after some experimenting with the shape of the combustion chamber, and with practically the same amount and class of work to dry, proved that it required 169½ gallons per 24 hours with the same amount of attention as, owing to the changes of external temperature, the flow of oil would vary considerably, though this could probably have been corrected by the use of a heater. If we take oil as low as two (2) cents per gallon, this would amount to $3.35 per day, omitting the cost of compressing the vaporizing oil. On this basis, coke would still be cheaper, at even $5.50 per ton, and with proper draught and a pyrometer, there is no trouble keeping a uniform temperature. Altogether, we have found this down draught oven a most satisfactory and valuable adjunct to our foundry department.

Pneumatic Tools.

We take pleasure in presenting a series of illustrations herewith, exhibiting some of the ingenious economic tools manufactured by the Chicago Pneumatic Tool Company, No. 635 Monadnock Bldg., Chicago, Ill.

The hammers, shown in figure 1, are familiar to readers of THE FOUNDRY, they having been illustrated in our columns for a long time past; yet it is possible that many of our readers may not have paid to them the amount of attention to which they are entitled.

There are, as may be seen, four castings in the illustration with heavy fins around the edge of the hole. It is generally thought inadvisable to have the core fit the prints very closely at this point. The molder therefore enlarges the size of the core print just here, thinking it better that the firm should have to bear the expense of the extra chipping than to incur the danger of a "crush," which would utterly spoil the casting. Where many such castings are made the cost of chipping is, of course, a very considerable item of expense. There is a great difference in the ability of different men in chipping castings; a really good chipper will do three or four times as much work as some other men who are employed thereat. But the makers of the pneumatic tool aver that it will enable one man to do more and better work than three men in the ordinary hammer-and-chisel way. We have every reason to believe that this is true. It would seem, therefore, that the progressive manufacturer who is all the time hunting for leaks in order to stop them might do some pretty effective "calking" right here.

The tool is, obviously, a labor equalizer. That is, the awkward man who can make but little progress with the hand hammer and chisel, may be able, with the pneumatic

FIG. 1.

FIG. 2.

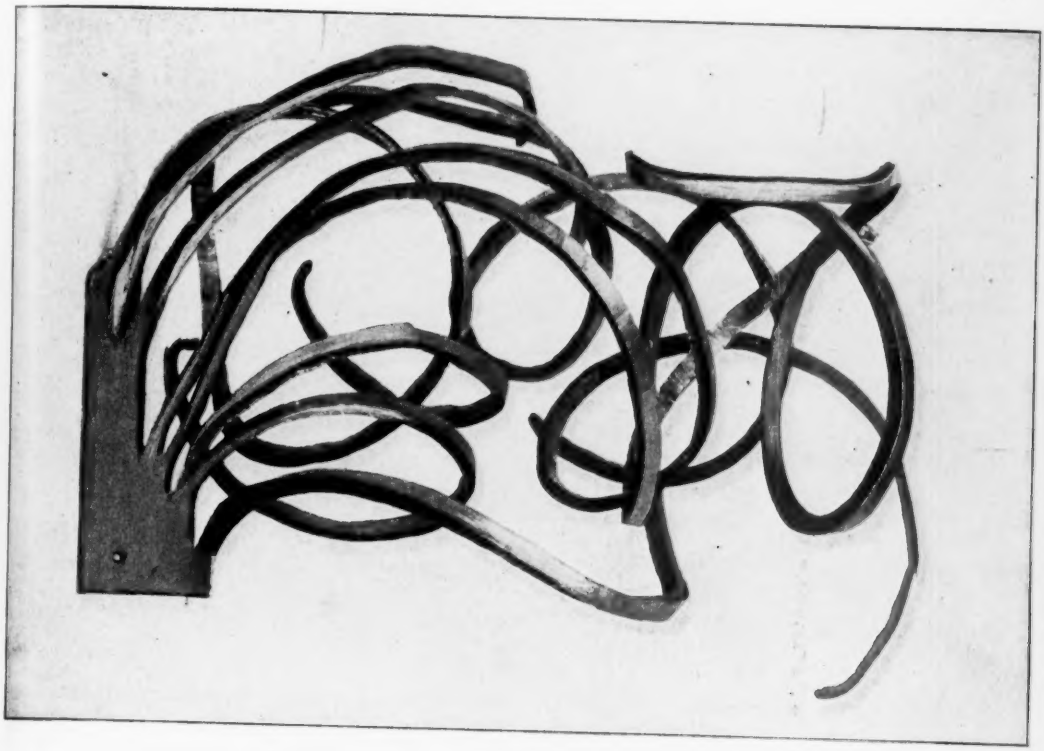

FIG. 3.

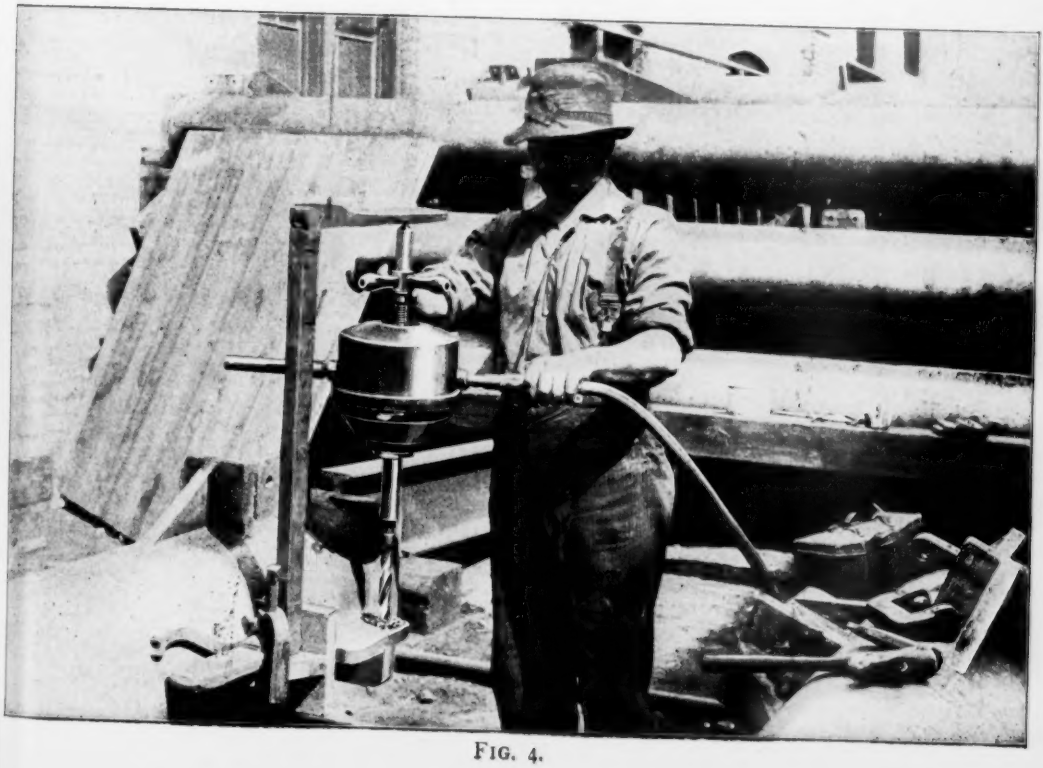

FIG. 4.

tool, to do fully as much work as his more dextrous shopmate.

Figure 2 shows the workman chipping the projecting ends of chaplets, and other blemishes, from the outer surface of the cast iron columns.

There often appears on an otherwise perfect casting an unsightly swell, all the more conspicuous because of its being the only blot upon the general symmetry of the casting. Such a "bump" rapidly disappears before the quick-acting pneumatic chisel.

Figure 3 is a graphic exhibition of work done in steel by this handy tool. We apprehend that an ordinary workman would have smashed his hand several times over in doing this job with a hammer and chisel. We call special attention to the approximate uniformity in width of these chips, from the beginning to the end of the cut, in each case. As every machinist knows, it would take a skilled mechanic to do this with the hand hammer and chisel; and he would be very tired of the job before the end, at that.

In figure 4 we are shown a very different application of the force of compressed air. Here, the drill press, in substitution for the slow-acting ratchet drill, is carried out into the yard where the heavy, unwieldy casting lies, a rubber hose is carried "over, through and under" all intervening obstacles (or rather objects—for nothing rises to the dignity of an obstacle in this case) is quickly connected, and the hole is drilled in a trice.

Figure 5 shows the same machine working in a horizontal position, and happily illustrates its facile adaptability to the many conditions that arise in everyday foundry work. This little machine would make possible the doing of work by firms that otherwise could not touch it, for want of shop room for such large pieces, and its convenience and rapidity of execution recommend it to all.

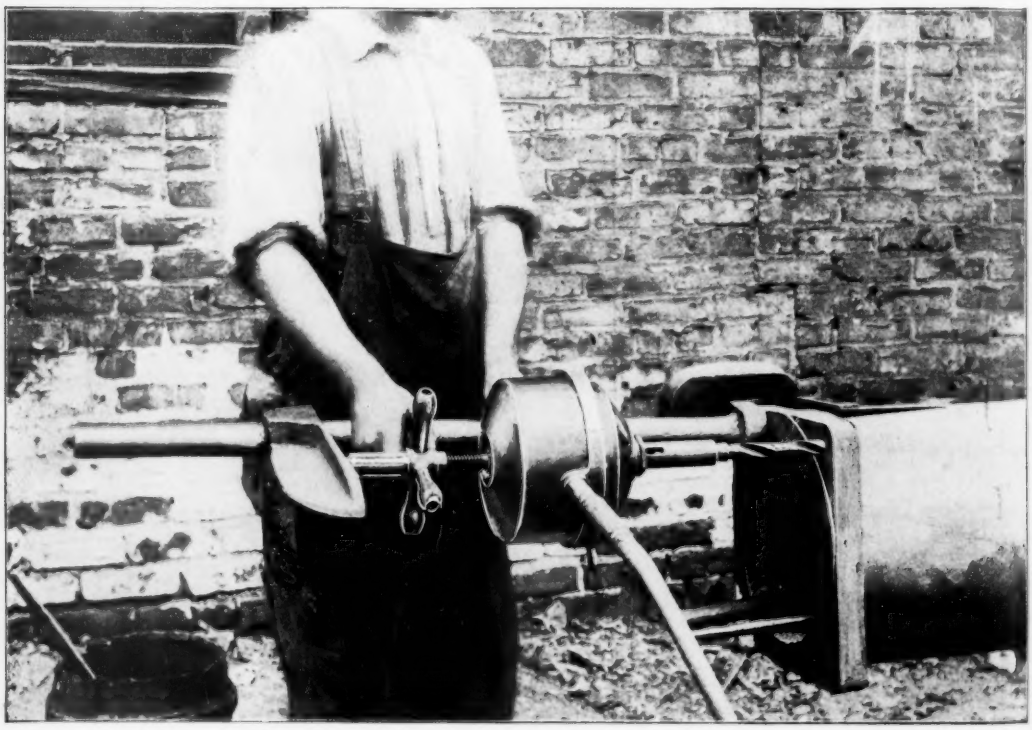

FIG. 5.

Figure 6 shows the air hoist handling heavy cast iron columns in the yard. The cylinder is hung to a car which traverses the I beam frame, spanning the yard, and resting upon double-flanged wheels at either end, which latter travel along the tracks that may be seen attached to the buildings, thus permitting the use of the hoist at any point in the whole yard.

The air is conveyed to the cylinder by means of the hose which may be seen hang-

ing in festoons along the track on the left.

This is a traveling crane, operating, in all its movements, by means of compressed air, the man at the top being the "engineer" who manipulates it with ease and precision. The hoist is operated by the men below.

It is claimed by men who have had large experience with compressed air, that it is by far the cheapest means for transmission of power, and the many uses to which it can be economically applied are rapidly popularizing it in foundries and machine shops.

One feature that should be well considered and never lost sight of by any one studying the question is the extreme simplicity of the means necessary to distribute the power stored in the compressor over a large territory. If you wish to use power a few hundred feet beyond the present terminus of the system, simply attach the necessary length of pipe, couple your machine to the end of it and it is ready for operation.

Figure 7 is a syphon sand blast. In this machine the material used is wet, thus avoiding the dust ordinarily caused by sand blast machines. Steam is used for a blast, which helps to remove scale, etc., and also aids in keeping down the dust.

Steam is discharged through a 3-16 or 1-4 opening, and throws the sand through a 3-4

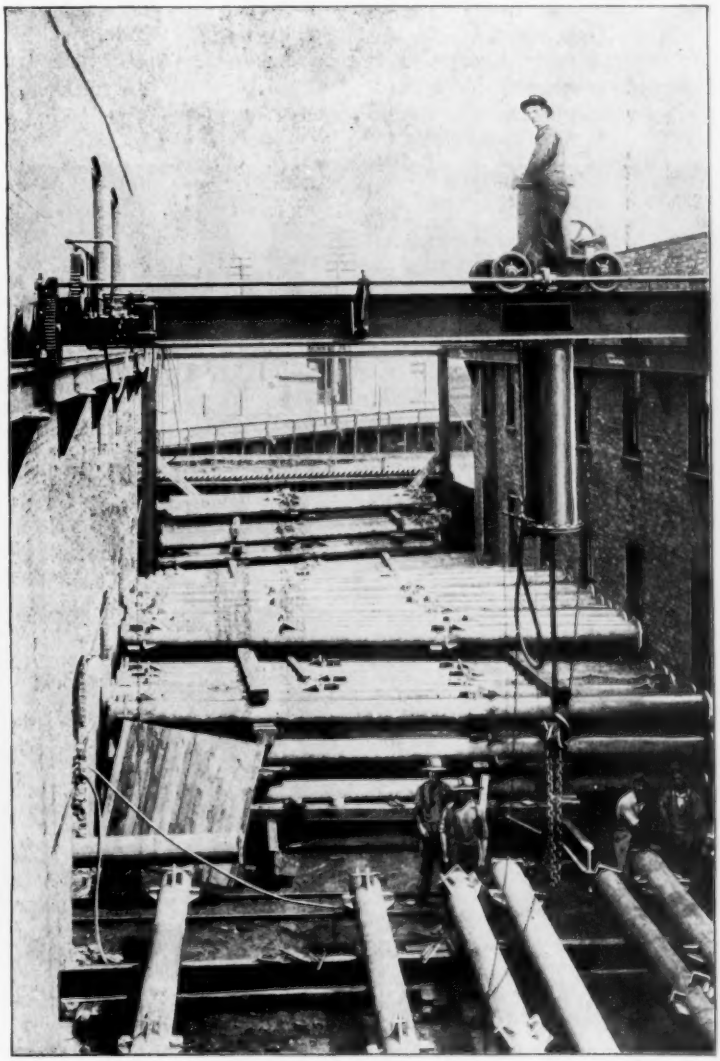

FIG. 6.

in. pipe. The machine is very simple in plan, but is thoroughly well made.

All bearing parts are protected from sand by shields and felt washers, so arranged that no sand can pass them. This insures wearing quality, and makes a machine that does not get out of order.

Where arranged to save sand used, about a load of sand is used per week; a machine will handle about a half load per day, if all is lost.

The above is based on ordinary beach sand. Where torpedo sand or quartz is used, of course it does not wear out as rapidly, and will last longer. It will be observed that this machine does not require the air compressor. It is to be connected with the steam boiler by means of a small pipe, so that anybody who uses steam power can install it at a merely nominal expense.

There are a good many uses to which the sand blast can be profitably applied, and in some cases nothing else will answer as well.

It is, as all foundrymen know, very difficult to get the sand off from a heavy casting where facing has not been effectively used. The steel casting brush is entirely inadequate, and very often the casting has to be hammered all over; which is a very slow and unsatisfactory process. Of course, it can be done by pickling. But this process requires a good deal of time and is comparatively expensive, and when the business is not well understood and carefully conducted the results are often very unsatisfactory.

In using the sand blast, if you want to clean a casting "right now," it can be done with ease and expedition, and "to the queen's taste."

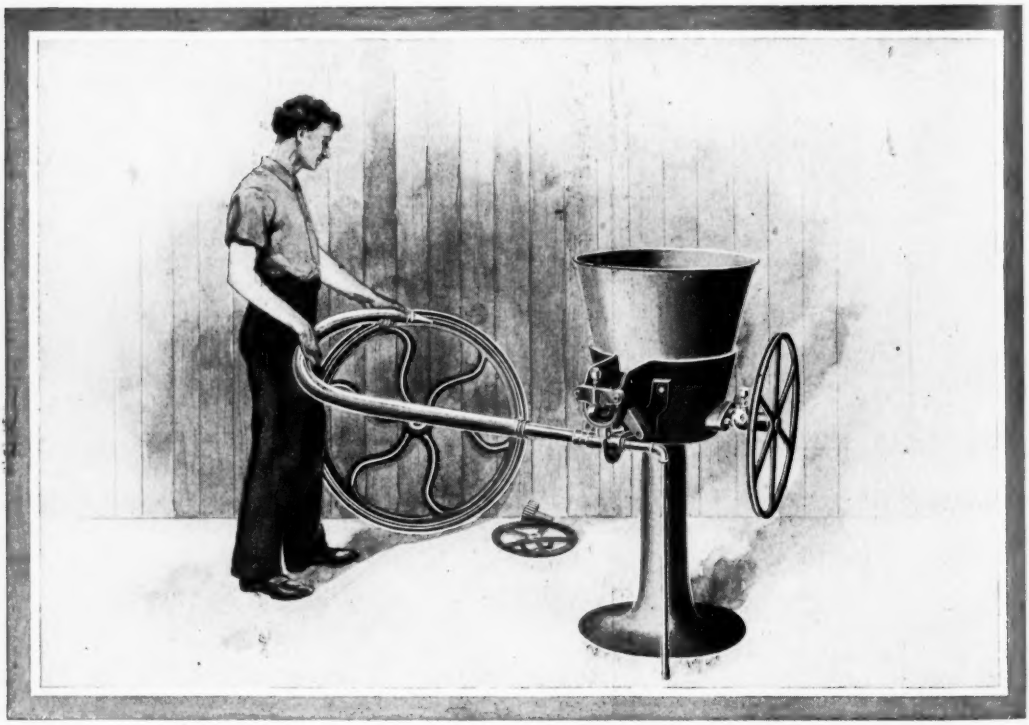

FIG. 7.

The Evolution of the Pulley Arm.

BY R. D. MOORE.

In the pioneer days of pulley manufacture in the United States, when lathes cost a little fortune, the faces were generally finished with a piece of grindstone, the rims being made very thin under a wrong impression about the true economy in the case. The arms and hub were made quite heavy, probably under the reasoning that they had the big load to carry, the rim being an arch, and therefore very strong.

Such a combination suggests lots of trouble, due to the great shrinkage strain given by such disproportions in thickness, and the consequent uneven time of cooling.

The weakest arch in those thin rim-segments would be very liable to fly off in two pieces with a velocity that would be dangerous. I have witnessed such cases in the long ago. An attempt to put back such a segment would give a convincing proof of the ton, or more, of force stored in such shrinkage strains on even a small pulley.

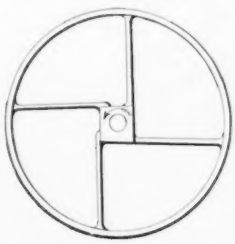

Fig. 4
Another Elastic Spider.

Fig. 2
Three Favorite Arms.

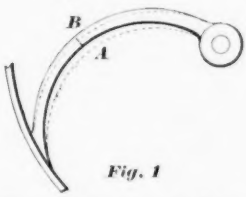

Fig. 1
The way they are broken.

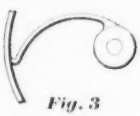

Fig. 3
A Flat Arm.

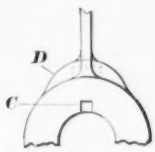

Fig. 5
Reinforcing a Hub.
The Foundry

A very common error among mechanics is that if you add iron to a casting, a pulley rim for example, the added cost will be as much per pound as the general cost of the casting; the real added cost is only the price of the melted iron, much below one cent per pound at this time. And that thinness of pulley rims, united to excessively heavy spiders, has been the principal factor in the trouble and heavy losses in the past, by the breaks, and it is still going on to a limited extent, very few molders, or other mechanics, ever taking the deep interest in this interesting study which its importance justifies, that is, the cause and remedy of shrinkage strains on castings. And that is certainly one of the simplest of the many foundry mysteries.

One of the principal values of this study lies in the resulting saving of wheels and pulleys from breaking under such strains.

Nearly fifty years ago, my first year in charge of the Niles & Co. foundry, Cincinnati, a customer asked to see some pulley patterns. On seeing them he remarked: "Why, you are using crooked arm pulleys out here. We have condemned them in Massachusetts years ago."

That remark opened up a new line of study. I knew the curved arm was intended to yield and relieve the shrinkage strain which, without it, was often sufficient to break the casting, and it certainly does relieve that strain, and yet I believe the paradox is well established that the straight, though rigid arm, is decidedly the preferable one.

The mechanic who introduced the curved arm can properly be credited with a bright idea, but "there are others." In the early days of badly proportioned pulley patterns, I run all the small sizes, say below thirty inches, with two ladles, through skim gates into the rims, thereby increasing the heat in the rim, and decreasing the heat in the spider, which with the early stripping of the hub made easy work of saving them.

The shrinkage strain on a straight arm is entirely a tensile strain, every fiber of the metal helping to resist the pull, but the curve in the arm changes the character of the strain entirely, it being a tensil strain on the inside of the curve, as at Fig. 1 and a compression strain on the outside at B.

Under this strain the arm will move toward the dotted lines. The curved arm of a four-foot pulley may be regarded as two levers over a foot long, the outside at the breaking point B, Fig. 1, forming the bearing for the levers in tearing the inside A apart, that is, one side of the arm furnishes the means for its own destruction.

The curvature of the lines of a chain link should be weakening also on this same principle, and it is probable that a link will break under a less load than two bolts of the same metal under a straight pull.

Fig. 2 shows three styles of curved arms that have been generally adopted, all oval in section but all finally condemned, by

many mechanics on account of weakness under the strain due to unequal cooling and shrinkage.

Several other curved arms have been used, one a flat arm set on edge, Fig. 3, a shape capable of standing a greater bending strain than the oval arm but very weak in the direction in which its work requires strength.

Fig. 4 presents another arrangement of arms intended to "give" under the shrinkage strain by the hub, relatively to the rim, revolving in the direction of the arrow. Two modes of fastening the arms to the hub are shown. With the light that we have before us the remedy for this trouble seems a very simple one.

Compel your pulley to cool and shrink in about the same time, not amount, by equalizing the thickness of the metal as near as possible. Pouring in the rims will be found a great equalizer of the heat in bad cases.

Hurrying the cooling of hubs by pouring water on the outside is often justifiable.

Additions to a hub to compensate for the weakening effect of a set screw hole, or key way, should be very carefully made, as any surplus or useless metal adds to the shrinkage strain. I have witnessed some interesting attempts to strengthen around a hub key way. Fig. 5, a hub of an old style cog wheel, illustrates our point, the dotted lines showing the strengthening additions so-called; they give no strength but rather weakness by destroying the arm fillets.

The dividers don't lie; set them to span the thickness of hub, allowing ¼ inch extra to compensate for the weakening effect of the square corner of the key, the point at which a break will always start. Now set your divides at the corners of the key way C and strike the line D.

There appears at first glance to be a surplus of metal, but the thickness to break is the same in all directions and therefore correct. A pulley arm broken by shrinkage strain will separate, say 1-16 of an inch; we can imagine what a great force would be required to draw the two ends close together again and yet that force exactly represents the pull on that arm before separating.

The principle on which the different arms are broken has many illustrations in common life. The cook snaps her beans easily by a short bend just as the curved arm is broken.

A giant can't break a match by a straight pull, as the straight arm is broken, but the fist of a baby can break it easily by a cross strain. A baby can tear a sheet of newspaper in half by commencing at one end, but roll a few inches of that sheet into a rope and it will hang a giant, because, as in the straight arm all the fibres are resisting the pull.

Further Light on Unequal Shrinkage.

The cases mentioned in your last issue in the "Question" under Cast Iron Notes, requiring explanation of the fact of the greater linear contraction occurring in the larger section of irregular shaped castings was further illustrated and explained by Mr. Keep's report of his experiments. But the matter recalls to the writer the tersely expressed paper of Mr. Francis Schumann on the "Contraction and Deformation of Iron Castings," Am. Soc. Mech. Eng., Dec., 1896, which ought to be studied by every foundryman, or at least every FOUNDRY reader. Without going into the valuable table and formula which Mr. Schumann deduced from many experiments, the following quotation from the general laws advanced answers the above question most aptly and philosophically:

"In any prism, unsymmetrical in section, composed of a smaller mass joined to a larger, the greatest longitudinal contraction will occur in the larger mass. This apparent contradiction to the general law, that contraction decreases with the mass and rate of cooling, is explained when we consider volumnar contraction. The larger mass will have its rate of contraction equal in all sections; the smaller mass is restricted in its contraction longitudinally by the larger mass at the point of juncture of the two masses, but maintains its greater rate of contraction transversely; were the transverse rate the same as that of the larger mass, its longitudinal contraction would be the same, but its transverse rate being greater, the excess in volume flows in the direction of length, resulting in a greater length, after cooling, of the smaller mass."

Considering the case of a wedge shape and an iron of low rate of contraction, it is possible to see how the above law has at least modified the result, though the heavy part shows convexity and slightly less contraction than the edge. A study of actual calculation by Schumann's methods will make this plainer.

Yours truly,

ASA W. WHITNEY.

THE FOUNDRY

Published Monthly by

"The Foundry Publishing Co."

DETROIT, MICH.

JOHN A. PENTON - - - EDITOR AND MANAGER.
E. H. PUTNAM, - - - - ASSOCIATE EDITOR.

SUBSCRIPTION PRICE:

$1.00 a year in advance, postage prepaid in the United States, Canada and Mexico.
$1.75 a year to other countries, postage prepaid.
Single Copies, 15 Cents.

Advertising Rates are Printed in Each Issue, on Page Containing Alphabetical Index to Advertisers.

Space in advertising pages only is for sale.

We invite correspondence on subjects pertaining to any part of the foundry business.

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The Detroit News Co. will supply the trade with THE FOUNDRY, through the regular channels of the American News Co.

Entered at the Post Office at Detroit, Mich., as second-class matter.

Trade Outlook.

The tide of reviving industrial activity continues to rise. There is no mistaking the fact that men in most lines of business look forward with confident expectation of splendid things for the near future. Foundries here and there that have been lying idle for a long time are being started up; others that have been hard pushed to ride out the storm of adversity are making headway toward smooth water. The fact that an advance of 5 per cent in the price of stoves is possible, gives incontrovertible evidence of growing prosperity. The enormous outflow of our products to foreign ports may possibly be in some measure checked by rising prices; but this would be a gain rather than a loss if the aggregate demand be not affected.

In fact, the evidences of business revival are so numerous and so patent to every observer that it needs no pointing out of particular symptoms to readers who are, in fact, fast becoming too busy in supplying present demand for their goods to give much time to figuring on the prospects for the future. The general faith manifested in the auspicious outlook is creative in its character, and will carry industrial society onward and upward in spite of all obstacles.

The stove factories are in the height of their busy season, and are rushing work to the fullest capacity. The same may be said of the agricultural implement manufactories, with the addition that these latter will, in all probability, be unable to fill the unprecedented demand for their products; and this is a fair indication of the condition in other lines.

Plow-Makers Ought to Get on to it.

In our August issue appears an article on "Manganese Steel," in which it is said to be so strong as to be almost unbreakable, and so hard as to be nearly unscratchable. For instance, an elevator cage, with car, fell down the well and was smashed to smithereens, except the wheels, which were of manganese steel! As to hardness, a casting of this metal was held to an emery wheel for ten minutes in an effort to dress it down, and the result was a solitary scratch! Now, as strength and hardness are the two essential qualities of the plow, this would seem to be the ideal material for their manufacture. There might be some difficulty in polishing plows of this make, but we would suggest that the plows be first marketed in the rough in sections of country where the soil is of a sandy nature, and, therefore, does not require the "scouring" quality. After they have been used here for 10 or 15 years, or long enough to put a smooth, beautiful polish on the surface, the manufacturer can purchase them back by giving in exchange new plows. Then, re-stock the old ones, and sell them at a considerable advance in price, for use in the black and waxy-land sections!

A Sea-Going Foundry.

Only a short time ago we heard of the first foundry on wheels. To-day it is an old story—the cupola on the car, wherein iron is melted wherewith to join the ends of the rails with a rigidity unapproachable by any other means.

But now, the good ship Vulcan, of the United States navy, is equipped with a complete iron foundry.

A little while ago the trade journals published a description of a foundry floor floating in a large tank of water. But this, if we remember rightly, was for the purpose of avoiding vibration. It is hardly to be presumed that they would "take off a heat" on the Vulcan during a very violent storm, though at just such a time the greatest need for a repair casting would be most apt to occur. But human ingenuity is equal to most emergencies, and the floating manufac-

tory is a pretty large item in evidence thereof.

The advantage of having this mechanical microcosm in the vicinity of the fleet at all times, in whatever waters it may be, can readily be seen.

There are many break-downs that can be with ease repaired in this marine factory that otherwise would necessitate an expensive journey, reaching to hundreds and sometimes thousands of miles.

The workmen on board the floating factory will naturally be skilled specialists, who can, better than any other men anywhere on land, do the work required.

To the practical foundryman an accurate description of the foundry facilities and processes on board ship would be interesting. One would naturally expect a good deal of spilling and spattering of hot iron. A sudden lurch of the ship during a critical "lift" would be apt to cause trouble; but, evidently, these difficulties are not insurmountable.

The ship is equipped with lathes, planers, shapers, drill presses, bolt cutters, tool grinders, forges and forge tools, power punch and shears and a full boiler-maker plant equipment, and also a molders' department with a cupola capable of melting 3,000 pounds of metal at each tapping. The force employed includes machinists, boiler-makers, blacksmiths, coppersmiths, pattern-makers and molders.

We venture the opinion that the "hobo" is unknown in this particular industrial community.

American Machine Works in Germany.

The Niles Tool Works Company, of Hamilton, Ohio, will build a large factory at Niederschweider, Germany, at a cost of $200,000, the capital of the company to be $2,000,000.

The Trade Journals' Review, of London, Eng., commenting upon this, advises English manufacturers not to have any fear of harmful competition from the backward Yankees, till they shall have had time to improve their methods by the study and imitation of the practices in England. There is a suspicion of insincerity in the above "whistling past the grave-yard," for the writer hastens to add: "Our machine makers would do well to bestir themselves at once, and take all possible measures to maintain the superiority of their manufactures, and at the same time to reduce the cost of production. By doing so in time, they may be able to retain their well-earned reputation and business connection."

A very few months ago, the Spaniard entertained a very deprecatory opinion of the "Yankee pig" as a soldier, and Europe in general scarcely seemed to know that we had a navy.

The unshorn Occidental giant "went out and shook himself" and principalities crumbled to the earth, while Europe wondered and admired!

Speaking of shipbuilding, the above authority says: "In German yards they will have ample opportunity of imitating British models, and, doubtless in time, they will be able to offer very formidable competition. Right here we wish to call attention to the fact that our brother John Bull has been trying for a considerable segment of a century to build a yacht capable of winning the America's cup, and with results rather discouraging!

The Swiss watch-makers at one time entertained a low estimate of our abilities in this line, but we made them change their minds, and that, too, without imitating their methods.

We assure our transatlantic brother that we shall not encroach upon his rights or privileges by copying his methods. We have not the time to spare. We are going forward; and if John Bull would keep company with us he had better get a big move on, and do it quick.

Shape of Test Bars.

In Dr. Moldeke's very able paper with regard to uniformity of methods for testing cast iron, he suggests, for the tensile test, a pattern, notched at the middle so as to insure its breaking here and nowhere else, in order to prevent the bar from breaking at some defective point, which would render the test of no value. It seems to us that the question of crystalization should be taken into account right here. This shape will cause a different arrangement of the iron crystals, which may affect the strength at this point. And if so it might be better to turn the notch in the casting instead of in the pattern.

Some one of our experimenters might practically determine the question by trying a

considerable number of bars made in both ways, and comparing results. Say, companion bars be made, one of uniform section, the other notched in the pattern. Then turn the notch in the castings from the former to the exact size of the latter. This, it seems to us, would be a practical way of determining the matter.

Ought to be a Success.

If "keeping everlastingly at it" insures success, then surely the Chicago Hardware Foundry Company ought to know it. We don't know whether Mr. E. P. Sedgwick, sec-

E. P. SEDGWICK.

retary and treasurer of the concern, would voluntarily stick to the business or not. We think it safe to assume, however, that heredity has much to do with the tenacity of his grip on iron founding. And, if practice makes perfect, and if there is any truth in the law of heredity, then it's no wonder that this firm makes the "highest quality of light grey iron castings."

As will be seen from the following, Mr. Sedgwick's remote ancestor, 250 odd years ago, built the first iron foundry in America.

The following is taken from the Encyclopaedia Britannica, American Supplement (page 2672):

Robert Sedgwick, a colonist, was born in London, in 1590. He was engaged in mercantile pursuits until 1635, when he removed to Massachusetts.

He was always prominent in the affairs of the colony, being a representative of Charlestown in the general court; a commander of the colonial forces under Cromwell, and a member of a commission to govern Jamaica, where he died May 24th, 1656.

Among other things, he established the first iron furnace in America, in 1643, and was one of the founders of the Ancient and Honorable Artillery Company in 1638.

A lineal descendant of this ancient and honorable gentleman is still in the foundry business, Mr. E. P. Sedgwick, secretary and treasurer of the Chicago Hardware Foundry Company, North Chicago, manufacturers of highest quality, light grey iron castings.

Influence of Bismuth on Brass and its Relation to Fire Cracks.

The above is the title of a paper by Erwin S. Perry, read at the Buffalo meeting of the American Institute of Mining Engineers, October, 1898.

He prosecuted an elaborate series of experiments, and summarized his conclusions as follows:

1. Bismuth renders brass cold-short, and is similar in this respect to antimony, although the effect is not so marked.

2. Bismuth is a cause of fire-cracks in brass.

3. High brass intended for cold-rolling should not contain over 0.01 per cent of bismuth.

4. Bismuth produces hot-shortness in brass.

5. Bismuth is a cause of latent fire-cracks in brass.

"A Talk on Core Ovens."

This is the title of a booklet issued by the Millett Core Oven Co., Brightwood, Mass., U. S. A. An excellent illustration of this splendid core oven may be seen in the advertising columns of this journal.

A foundryman who has never used a modern up-to-date core oven has little appreciation of the loss daily sustained in the use of the old style ovens generally employed in foundries.

The Millett Company rightly claim the highest economy of time and fuel, and effectiveness of their oven's work.

We know from costly experience in this very line that it is far better to purchase from the manufacturer who has given years of study to the perfection of his product than to try and economize by the construction of a home-made device. The difference in cost to a man whose time is worth anything is all in favor of purchasing from the specialist. These ovens are in use in hundreds of foundries in the United States and in Europe, and the leading names in the manufacturing world appear in the list of patrons. The Westinghouse Air Brake Co. has 30 of them in their foundry, the McCormick Harvester Co., Chicago, has 12, etc., etc.

So it will be seen that one can not make a mistake in purchasing this, so popular core oven.

After the War, Business.

The usual result of war is to impoverish; but, in the case of the United States it seemed to have the reverse effect. Immediately after the prolonged civil war of '60-'65, the industries of the whole country expanded and developed with a rapidity beyond anything the world had ever known. And now, the sound of the last battle has hardly ceased, when the press throughout the country begins the daily record of enlarging business. The good times that we have been wishing and predicting for a long while past are materializing very fast, and very shortly everybody who wishes to be busy will be gratified to the full. The most difficult thing in business affairs is to advance the price of manufactured goods. There are two things that are equal to the task, viz., the trust, and excessive demand, long sustained. In view of the fact that there is no trust in the stove business, the recent decision on the part of a large number of heavy manufacturers to advance the price 5 per cent would indicate an active demand sufficient to warrant the step. It is also claimed that conditions point to a probable still further increase in the near future. They aver that since 1893 the prices of stoves have been lower in proportion than any other article of manufacture. Although this is sheer rot, and, as a matter of fact, the reverse, if anything, is true, yet the seeming possibility of advancing the price of any manufactured article of importance is strong evidence of the presence of better times.

One Way of Estimating the Value of the American Foundrymen's Association.

It partakes of the character of life, as compared with death. It is doing something, instead of leaving a blank in the activities of the members. The friction of interminglings men is something like the friction of castings in the tumbling barrel—it polishes. Polishing a thing makes it bright. Go to any section of country where the business men are exclusive, suspicious and secretive, and you will find the great majority dead in the shell, living from hand to mouth, and half doubting the expediency of continuing the dull, insipid struggle for existence.

You can't get much above your neighbors; and so, if you wish to rise higher you will do well to help your neighbor up a little higher also. Beneficent progress can not spring from repression and darkness. Let us have light, and lots of it.

About Dividing Responsibilities.

In an article in this issue Mr. West criticizes an editorial in the August FOUNDRY. If Mr. West and we had both given the term, metallurgy, the same meaning, there might possibly have been less cause for his adverse criticism. Metallurgy is no doubt, strictly speaking, much older than chemistry; for, we think it probable, that man worked in metals before he engaged in chemical operations. We are quite willing to concede that natural chemical operations may or may not have transpired prior to any metallurgical processes. We presume that on the first day the sun shone upon the earth its heat began the never-ending process of evaporation. Indeed, we presume that chemical action produced the very metals which, long ages after, metallurgists began to manipulate. But, seriously, what is metallurgy? It is certainly a word of much more comprehensive meaning to-day than when it was first coined.

A few years ago, the foundry metallurgist, or superintendent, gave not a thought to the chemical contents of his iron. As a metallurgist, he closely examined the fracture, and, perhaps, the appearance of the face of the pig. To-day, he does this, and also makes a chemical analysis of the iron, either in person, or by an assistant; whether the latter be a regular employe, or only an occasional helper. Now, the superintendent may be, and often is, employed because of certain personal qualifications that fit him for his

particular place, and he may be entirely ignorant of metallurgy. And an expert chemist may be, and often is, an adept in metallurgy. Now, it seems to us that an ardent advocate of chemistry in the foundry ought not to exhibit any violent objection to these two men being employed in the same foundry, each having his peculiar assigned duties to perform. We have no personal feeling in this matter. We don't care a rap whether the superintendent or the chemist be the one best fitted for the work of the metallurgist. But we think that the term metallurgist covers a wider range of activity in modern founding than formerly, and we are unable to see that any violence is done to philology when we include in these activities the chemical analysis of pig iron. We agree with Mr. West that the practical foundryman ought to be the head of the whole business, but we opine that for any one man to fill all the lines of work here indicated, in a large foundry of the present day would be an impossibility.

If he is not a good man, you don't want him; if he is a good man, don't kill him with overwork.

Western Foundrymen's Association.

Discussion on Inspection of Castings.

A paper entitled "Inspection of Castings," by E. H. Putnam, was then read. This was read at the Cincinnati convention of the American Foundrymen's Association, and appeared in the June Proceedings.

Mr. Carver: In one of our leading agricultural works, I understand it is the practice with certain kinds of castings, such as mower wheels, to make them and stack them up out in the foundry yard, sometimes for one or two months before they are tumbled and given any chance for inspection. I would like to know what foundrymen think of that plan in the light of this paper read here urging more prompt action.

Mr. Walker: You spoke of some founders packing mower wheels out in the yard for a certain length of time without cleaning; circumstances might compel them to do that, still I should think that would hardly do if they are being made by the piece. We all find it very hard to come back on to a molder after a casting is a few days old, for the making of it, for there is always a question as to whether he made it or did not make it. All inspection I have anything to do with is done almost immediately after they are cleaned. This paper speaks of laying out the whole floor. I should think that hardly practicable; for castings go through a certain process, are turned over to the grinder and shippers and we are supposed to have men of intelligence enough to know when they run across a bad casting and throw it out. We always lay the bad work out; every day's product has inspection, and all that goes through is supposed to be good and that is the last we hear from it.

Can You Tell Him?

Question: Mr. J. R. Wagner wants to know if any foundrymen are supplying gas retorts without facing by machine, and if so, how are the joints made?

Plumbago Club.

By SAM DUE.

One of the saddest things in the history of this remarkably slick club has come to pass. An event which, if the increasing tide of discussionis not promptly choked off, will cause our name to become a ghost and a part of our members die as paupers. A large number of our members manage to make a suspicious living selling (or trying to sell) foundry facings, blackings, plumbago or silver lead foundry supplies and foundry equipment, or any other old thing a foundryman needs or they can sell him. The mistake of one of these members will undoubtedly cause the balance of them to pass sleepless nights and bad checks, have Vertigo, St. Vitus dance and no money. It appears to have started at a late meeting of a certain foundrymen's association, and has become the sole conversation of any number of all kinds of salesmen who may come together. No difference whether they sell eggs, shoes or bridges, chewing gum, flags or beef. The consensus of opinion is that the howling mistake of the profession was made, and the perpetator made a bad botch of it. At the foresaid meeting he read a paper, "Foundry Facings and Their Uses," compiled from old catalogues and his own opinions interposed. It is the same old chestnutty talk of the large number of retired facing salesmen who were forced to the bench because they never knew when to change the subject; the same old

stuff which the old foundrymen tell us about, and which made them make their sons athletes and placed them in charge of their foundries.

The old facing salesman when he meets one who has just started on the road to sell facings, stands, sits and drinks for hours warning him to refrain, above all other things, from telling foundrymen how to use the goods he sells, what they are made of and the actual cost to the boss. Added to this he was particularly cautioned against the enticing invitations of flattering editors of foundry journals and secretaries of foundrymen's associations who wanted him to write a paper on "Foundry Facings and Blackings—what they are, and how to use them." I don't believe there is an old facing salesman in the Plumbago Club who has not been asked 106 times, by the watch, to write such a paper for publication; and who did not 106 times, by the watch, politely refuse to do so. Now it has come to pass that one of our young members has written and read one.

The pressure was too great for him and he accommodated them. As soon as he had finished reading, a foundryman arose and said he would be much pleased, and he knew every foundryman present would be equally gratified to hear from a gentleman, who was present, that has the reputation for making the finest and most beautiful castings made in the west. According to an eye witness, 26 men immediately arose, before the speaker had time to mention the honored gentleman's name. But as soon as he told to whom he referred the 26 gentlemen quickly seated themselves and a nice, clean, modest man of some 60 years arose and slowly said that he was much embarrassed with the compliment, and what he knew about facings would be a very long story. He then went on to tell them what kind and whose brands of facings he used that made such nice castings, following by some very pungent points as to the reasons that good facings sometimes did not work, informing his listeners that "flat gates, too much facing," etc., etc., were the main causes of rough and bad castings. His remarks were all right and his statements appreciated. After he was seated a foundryman stated that he understood the previous speaker to say something about "using a heavy facing and topping it off with a lighter?"

What does he mean by a heavy facing; sea coal? By all the heat in the sacred cupola; by all the powers that be; after all these years of hard work by facing salesmen, foundry journals, technical schools and catalogues, here is a man gets up in a foundrymen's association meeting and wants to know what a heavy facing is, who actually don't know the difference between heavy facing and sea coal?

The gentleman who makes the finest castings in the west answered the question nicely. He understands how to make fine castings because he knows what facings are and how to use them.

But the climax of the whole thing, the "live softener," was the remarks of a foundryman who followed, to the effect that all facings were bad. "There is no such thing as a good facing; there is a time coming when facing men will have to get in some other kind of business." He continued, saying: "When I came to Chicago I found them using facings on bath tubs. He watched the molders who were almost all machinery molders and not accustomed to the nice use of facings."

"The facing was good, but not properly handled. I have abandoned the use of facings completely and am now making better castings. I have made better work without facings than I have with them." (No wonder.) Such contradiction.

The above remarks must have tickled a few more, for the next gentleman remarked. "I have had some little experience in the use of facings. I have had my ups and downs, I feel the same and I hope the time is coming when we can do without facings." He concluded by stating "that he had worked in stove plate shops, but not in connection with the facing."

Did you ever hear such preposterous statements. He says he has had some little experience with facings and finally ends up with admitting that "he was not in connection with the facing." The discussion was handled by another gentleman, who stated that he remembered the time when he was glad to have a facing. Then he says, "If I want to use a pattern with a real nice figure I never put on a facing. I take charcoal and shake it on the pattern. I never face it afterwards."

How ridiculous! What is charcoal? Isn't it a facing?

Then the gentleman who said all facings are bad and compromised the sentence in one breath by stating that facing is good, but molders don't know how to use it, following here by saying, "I am accustomed to make light castings. I did not mean that the time was coming when we could make castings of twenty tons without facings." Yet he said in his first remarks that facingmen will have to get into some other business. How confoundedly inconsistent. He continued saying, "Another difficulty in the use of facing is, you get the best grade of facing and put it in your facing box. Some fellow does not grease his pattern and it sticks." (What would it do if he did grease it?) "He conceives the idea of putting some return facing in with the heavy facing, or if he happens to have any soapstone around he puts in soapstone. Bill sees Jim, and he thinks it is a good thing, and Tom puts in a little more, and the first thing you know you have a mixture." And this is the gentleman who said all facings are bad; that there is no such a thing as a good facing. Do you think he would know a good facing if he saw one? Do you think if he made a good, bright, clean, smooth, pretty casting he would give good facing any credit for it?

Now, what is the opinion of good molders and foundrymen as regards the outcome of this meeting? It is undoubtedly in favor of the use of good facings. The gentleman who makes the best, finest and smoothest castings in the west, the one they were so anxious to hear, told them plainly that his castings were made by good, practical molders who know how to use facings, and their foundry as well as the proprietor has the reputation for good work, and they all have a good word for facings. So it is with every foundryman who understands his business, and it is only a very, very few, who attend these association meetings who, to get their name in print, have to take the wrong side of a subject. Facings are necessary as anything which go into the manufacture of castings. They are necessary to cover the surface of the mold to prevent the burning out of the vegetable and other non-fire proof matter that is found in molding sands. They are necessary because they give to the surface of the casting a smoothness and brightness that cannot be obtained without their use. Milling a casting will give it a brilliancy, but will not make a rough surface casting smooth. Facings effect a saving that is appreciated by all up-to-date foundrymen. They know that they can turn out work that is satisfactory to themselves and employers, and that means more work for the shop, for the customers are satisfied and saves them labor, enabling them to turn out more work, which means more money or more rest. So brace up, ye down-trodden, good-hearted, anxious, philosophical complaint listeners. Let not this escapade of one of our unsophisticated youngsters any longer give you fear of continuing much longer in a calling which is surely an escape from Hades, but plod along, forgetting this trivial trouble, in the unsurmountable difficulty, which is now presenting itself, the leading question of the next discussion of the club, "How to overcome the 175 per cent advance in the prevailing price of Crude Ceylon Plumbago and East India silver lead, and the intricacies and troubles ahead caused by over-adulteration."

Malleable Iron Melting.

PART II.

Malleable iron mixtures are, as a rule, melted in the reverberatory or air furnace, although the cupola is used in some cases for light work, where strength is not the most important feature. These furnaces are constructed with the view of keeping the impurities of the fuel from being absorbed by the iron, and hence the fire-box is separated from the reservoir containing the charge, by a bridge wall, over which the flames pass before coming in contact with the iron.

Although this is by far a more expensive way of melting than by the cupola, it has several advantages other than the separation of fuel and iron. Among these, the time saved in pouring is not the least. A six-ton heat can be run out in about half an hour, and at least three heats a day can be run without inconvenience, from each furnace. This is a great saving of time, compared with cupola practice, and helps the tonnage of castings produced very materially.

The roof of the furnace is divided into sections, or bungs, and a few of these are raised, after the furnace has become well heated, and the charge thrown in, first the sprue and discounted work, then the pigs. This is usually done by hand, and consumes from twenty to thirty minutes. The wind

is then turned on, and firing carefully attended to. In an hour, or little longer, the charge is poked over, and lumps of unmelted iron separated, and the different grades mixed. This is usually done at least twice, and then the slag is skimmed off through a hole in side of furnace. Two skimmings are made by most furnacemen, about half an hour apart. After the last skim, and when the charge has been given a short time to recover the heat lost during the last operation, the iron is tested for the purpose of ascertaining if the carbon has all entered in combination with the iron. A round bar is cast, cooled in water and broken. If the fracture shows a uniform white texture, the iron is ready to pour, but if the fracture shows small, dark spots (graphitic carbon), another test should be made. This test requires careful attention and judgment. If the iron is tapped out too soon the strength of the castings, after being annealed, is impaired; and if delayed too long, the iron is liable to become burnt in the furnace. In the latter case the annealed castings will be more or less hard and brittle, and show a fracture somewhat similar to unannealed, or white iron.

From time of putting wind on till tapping, a six-ton heat usually consumes three and a half hours.

The Early History of the Bell Business.

The early history of the bell business, carried on for the last seven years under the name of the Blake Bell Co., cannot be fully written for lack of records, but some of its first productions are still in existence, and from them we have gathered the following facts. About the year 1795 Paul Revere, of revolutionary fame, whose versatility appears to have been such that he was able and willing to do, or make, anything that there was a demand for, recognizing the fact that there was at that time no foundry making bells, while the calls for same were increasing, started in the business with two of his sons associated with him, adopting the name "Revere & Sons" as that under which the business was conducted and the bells marked. About a dozen bells were made that year, and from that time on the business appears to have been uninterrupted until the year 1803, when, from some cause unknown, one of the sons, Paul, Jr., left the company, and we find the bells marked "Revere & Son," and later on "Revere," when, at the organization of the "Revere Copper Company" to manufacture bolt and sheet copper as well as bells, Paul, Sr., apparently withdrew (dying in 1818.)

It does not appear that the Revere Copper Co. made any special effort to continue the bell business, probably finding the copper business more profitable or calling for their entire attention. The bell business was, therefore, finally abandoned by them.

In 1820, Mr. William Blake, a young man, probably as thorough a mechanic as could be found in the City of Boston at that time, by some means was brought into business relations with Paul Revere, Jr., the son who had not been with his father in business since 1803, and they, Blake and Revere, commenced again the making of bells, but under what name, or whether in connection with any other business is unknown.

How long Revere was associated with Mr. Blake is not on record, but in 1823 was formed the Boston Copper Company, with Mr. Blake at its head, showing that they too saw in the manufacture of copper something attractive. No knowledge is had who Mr. Blake's associates were for the next five years, but in 1828 a co-partnership was formed between Henry N. Hooper, William Blake and Thomas Richardson, under the firm name of Henry N. Hooper & Co., and was continued under that style until 1869, the company being by far the most important of its character in the country, making not only bells, which it shipped to all parts of the world, but metals of all kinds for ship use, such as sheathing and spikes, lamps and fixtures for oil and gas, bronze cannon for the United States government, and most of the machine work for the Lighthouse Department.

In all this work Mr. Blake was the mechanic whose ability enabled them to attain this prominence, although, as is often the case, his name was obscured by that of his associate, whose duties were confined to the offices and selling departments.

On the 1st of January, 1869., Mr. Hooper and Mr. Richardson being dead and their interests withdrawn, Mr. Blake formed a co-partnership with his son, William S., who had for some time been in the employ of the company as a superintendent. The name of the firm was William Blake & Co., and was so continued up to 1890, although Mr. Blake, Sr., died in 1873, leaving William S. alone in the business. Circumstances arose in 1890

whereby Mr. Blake lost the ownership of the business, but he continued to manage same for other parties, under the name of the Blake Bell Co., up to 1893, when he withdrew, dying the following year. On the 1st of January, 1894, the business was purchased by Geo. H. Lane and by him continued until August, 1897, when their foundry being destroyed to make way for improvements, the condition of business being such that it was impracticable to reestablish it again as an independent business.

It is to be regretted that more is not known as to the location of the business when carried on by the Reveres, but no records exist, though it is understood that several changes were made.

The first location of permanence was in 1837, when a factory was built on Causeway street, Boston, upon a portion of the site of the present Northern Union Station.

Their next move, when driven from the Causeway street site to make room for the B. & Lowell R. R., was to a lot on Allan and North Charles street, near to the Massachusetts General Hospital, its last location. The elder Mr. Blake, who was something of a musician as well as a mechanic, early recognized the fact that, while the Reveres and others that had started in the businss, could make bells that would make a noise, that none of them were making bells that made music, and he therefore, with his usual desire to excell, set himself to work to perfect the shape of his bells so as to make them harmonious. He was the first bell founder in this country to recognize the fact that a bell was not an instrument or part of one producing a single note, but a combination producing a fundamental tone with several harmonics, or as it were a series of bells each a part of one bell, the principal tone coming from the sound bow or where the clapper struck, the others from below and above as the bell varied in diameter and thickness in correct scale.

As all of these tones are sounded together by the blow of the clapper it was evident to him that no bell could be called harmonious unless in each individual bell all of its tones belonged to the same chord, and it was to produce this by alteration in shape that he devoted his energies, the operations being an endless amount of experimenting and testing of every bell made, the changes having to be very slight at a time. In this work Mr. Blake was fortunate to receive the assistance of an English musician, Mr. Henry P. Monroe, a man who had been deeply interested in bells from childhood, and with an ear so acute that he could instantly, upon striking a bell, tell every tone it produced, and whether if harmonics were on correct letter, if they were sharp or flat, and how much.

His analysis of the tone produced by the English chime in Christ church, of this city, probably could not have been duplicated by any man in this country at the time it was done.

The result of the work of these two enthusiasts is to be seen in the present conditions of the sweeps or patterns for making bells in the foundry, there not being another in the country that can produce their equal. Their record covers the first chime made in the country, 8 bells, tenor, 2,000 pounds, cast 1825. The second chime in the country, 11 bells, tenor, 3,000 pounds, cast 1850. The largest bell (but one) made in the country, cast for the City of New York, weight 21,600 pounds. The largest bell to swing weight 10,233 pounds, for Androscoggin Mill, of Lewiston, Me., made in 1861; chimes and single bells all over the country.

Melting Practice.

To the Editor of THE FOUNDRY:

Dear Sir—I have been a subscriber to THE FOUNDRY for some years and am much interested in the notes, discussions, etc., on cupola practice as given therein, and I have thought that perhaps the remarks given below may be of interest to American readers of THE FOUNDRY.

We melt from 20 to 25 tons per day in a 48-inch cupola, having six four-inch tuyeres, 18 inches from sand bottom, and charging door 17 feet from bottom.

We use a coke manufactured from native coals exclusively. In our foundry we make cast iron water and gas pipes, fitting of all kinds, pipe specials and a general line of castings.

About two years ago we were using a coke made wholly from Acadia coal, ash about 20 per cent. With this I had considerable trouble, as it was quite soft and easily crushed; the blast would not penetrate charge, but found its way up the outside, thus causing the lining of cupola to cut badly. The best results I obtained from this coke were about one to eight.

I then tried a coke made from Drummond coal, with ash about 17 per cent. This was a very hard coke, and comparatively speaking the result was much better than when using Acadia.

With this last mentioned coke I melted good, hot iron about one to eight and a half.

I then thought that by putting in a three-inch tuyere between each of those now in use, this trouble would be obviated, and the blast more evenly distributed through the furnace; but being quite busy, and unable to shut down for any length of time I have not been able to try the experiment yet.

In charging the cupola we put in 1,600 pounds of coke for bed and 3,600 pounds of iron, then 300 pounds coke; after the second charge we put in 1,800 pounds of iron to 150 coke. We use limestone as a flux, using proportionately about one to twenty-five.

At present we are burning our own coke, using one-half Acadia and one-half Drummond washed coal; this gives us a good coke, ash about 14 per cent. We melt with coke about one to nine.

For heating core ovens and drying flasks we find, however, that the Acadia coke is better as it is softer and burns more readily than the harder Drummond coke.

Yours truly,

CHAS. L. JOBB,
Supt. Pipe Foundry.

Londonderry, N. S., July 25, 1898.

(If Mr. Jobb will describe his coking process, it would interest us much.—Ed.)

Economy in the Foundry.

By PAUL R. RAMP.

The cost of production in the foundry can be reduced in various different ways. A great deal depends on how much money the firm cares to invest in improvements. In a shop where a good foreman is in charge, very often nothing short of high-priced machines can reduce the cost any more than it is. For the foreman understanding his business has made a careful study of every job and gets it out as cheap as possible without the aid of machines. But there are many foundries where some of the most simple appliances are a great improvement. In a shop of this kind a good foreman is very often a more paying investment than a $1,000 molding machine. I do not want it understood that I am not in favor of molding machines, because I am. But every foundry in the country cannot afford to invest the money necessary to equip the shop with molding machines. And should they do so, unless they have a man who thoroughly understands taking care of and running them, they are not always such a paying investment. So it is plainly seen a foundry needs a good foreman first, then molding machines can be introduced to advantage. Take, for example, a shop where machines of every design are employed to produce cheap castings. There are always many other jobs that cannot be made on the machine, then if your foreman is not competent to make the job as it ought to be made or as cheap as it is possible the consequences are this job, as well as others of the same kind, will eat a great hole in the profits made by the machine. A short time ago I had the pleasure of visiting a foundry plant situated in one of our largest manufacturing districts. In showing me around my attention was called to a machine making cores for a certain job, with which I was greatly pleased. I thought the machine perfect and think so still; in fact the rig for the whole job was a decided success. But we stepped across the gangway where snap work was being made. There I found plenty of room for improvement, without the aid of machines. Of course, machines, providing they were the right kind, would have wonderfully reduced the cost. But another thing I did not like was the methods used in making and setting their cores. There were a number of jobs where a single core would have taken the place of their five or six smaller cores; the consequence being one larger core made, quicker and cheaper, besides the molder would have only one vent to take off instead of five or six on the small ones. I also noticed another job where a molder was making two castings in one snap. It was necessary for him to put four anchors on each core, two above and two below, eight in all, when all could be avoided by making the two cores in one, then he would have need of but one vent and no anchors, providing he nailed the two patterns on a board in the right position. This is one of the small things if carefully looked after will greatly reduce the cost of production in the foundry. It is not always necessary to invest $400 or $500 to make an improvement. It takes a man with brains to successfully run a foundry. He must be a molder and a first-class mechanic. We laugh at the idea of a "hog"

playing a piano, but we find men every day in charge of foundries or discussing the molding trade who have never had their hands in the sand. One can learn a great deal by observation, but 'tis like music. We can enjoy a good song although we can neither sing nor play. So can foundrymen enjoy perfect castings who don't know a gagger from a fifty-pound weight. Molding is one of the most complicated of trades, and the opinion that any intelligent young man can learn the trade in a couple of weeks is a mistake. I have the good fortune of being daily in the company of one of the most successful foundrymen of to-day. He is very near 70 years of age, still one of his favorite remarks is: "A man never gets too old to learn."

Dividing the Responsibility of Foundry Superintendency.

By THOS. D. WEST.

The editorial, "Let the Responsibility be Divided," seen in the last number of THE FOUNDRY, is one which the writer believes should not be allowed to pass as a correct solution of economically managing modern foundries.

The writer claims that to relieve a foundry superintendent or foreman of the responsibility attached to mixing and obtaining right grades of iron in castings, opens a door to no end of contentions, disagreements, weak management or possible ruin. To relieve a foundry superintendent or foreman who is qualified to be in full authority of directing the molding of all responsibility in making or directing mixtures, also relieves him of much responsibility in obtaining "good castings." Every experienced founder knows that it is a very easy matter to turn out "bad castings," the blame for which can be charged to either the iron or the mold, according as it may best suit the superintendent or foreman to render excuse for bad work, and with which it is to be remembered. "He is a poor molder that cannot give good excuse for a 'bad casting.' To be serious, he is a poor molder that cannot make two molds to be poured from the same ladle and have one give a crooked, cracked, chilled or hard spotted, etc., casting, and the other a perfect piece of work. A study of this fact should show the error of thinking to divide the responsibility of superintendency in constructing castings and illustrates one of the ways in which the president or general manager of an iron works or foundry would have difficulty in locating the responsibility for bad castings, as when he would counsel with his molder superintendent or foreman for bad work, he would be told to go to the chemist, etc., and vice versa. If we are going to divide the managing responsibility of metals and molds, we can as consistently divide the work of cores and molds, etc., as they are similar in their relation of responsibility and distinction of training to achieve the end of making good castings.

There is no trade so uncertain in its workings or results attained as founding. When the president or general manager of any iron machine manufacturing concern goes to their office in the morning, they feel fairly certain of how they will find the previous day's work of the machinist, boilermaker, blacksmith or patternmaker, but when they turn to the foundry department, they are oft fearful of what may greet their inspection, and know not if half of the shop's last cast will be good or not.

It would be interesting to hear from such presidents or general managers on the advisability of "Letting the responsibility be divided," some morning when all had gone wrong or the shop was filled with bad castings, but of which the molder superintendent or foreman would lay claim to being the metallurgist's or chemist's fault, and the latter in turn trying to lay the losses to bad molding. The writer is inclined to believe that most of such general managers would be far from encouraging the idea of dividing the managing responsibility of mixing metals and making molds, if such could at all be avoided, but instead advocate greater restrictions in making an individual responsible for the production of good castings, if such could be done. Surely there is enough uncertainty in obtaining good castings, without increasing its field of not rightly knowing who is responsible if they are bad.

If a firm believes their metallurgist or chemist is strongly better fitted than their superintendent or foreman molder to assume the responsibility for good castings, I would advise their assuming the responsibility. Better success would be had by such a course than by dividing the responsibility between two heads. If the writer were a metallurgist or chemist he would not think it a desirable position to be held responsible

for mixtures, while another would be held responsible for the results of molding. He would contend for going cheerfully as an assistant under an experienced founder. Such subordination need not in any wise lessen the usefulness of a chemist, etc., in aiding a successful attainment of desired ends in producing good castings.

Having reached the point where we will take it for granted as being best to have but one person responsible for good castings, the question next to be discussed is, which one is best fitted by experience and knowledge of founding to be raised to assume the responsibility, the intelligent molder, metallurgist or chemist? The editorial at its closing paragraph says: "Molding is a trade and quite a complicated trade at that." "Metallurgy of cast iron is a trade more complicated still." "It is more difficult to master than molding, for the reason that combinations alter each succeeding result." To discuss these statements it will be necessary to ask: What is metallurgy of cast iron? Then again who are the men that have done the most to augment and advance practical knowledge on the metallurgy of cast iron? Is it the men who are called upon to oversee properly preparing a cupola for melting clean hot iron, arrange for pouring to best insure a full run casting, devise a mold so that iron will best lay in it, give a casting free of dirt and blow holes, direct placing of feeding heads and feeding so that all parts of a casting will be sound, direct cooling, so that castings will come straight or to prevent their cracking, and a dozen other things that might be mentioned to show wherein, by ill directions, the work of the melter or molder can be varied to give ill or perfect results in casting, or is it the man who can obtain sufficient knowledge of iron to entitle him to be called a metallurgist without having ever labored long in a foundry. The writer believes that investigation would prove that nine-tenths of practical knowledge pertaining to the metallurgy of cast iron has been created and advanced by the melter, molder or the men who have risen from the floor to manage them. It is to be understood that this is not speaking disparagingly of the men not practical founders, who have and are at present honestly laboring to advance practical knowledge of cast iron. Some of these are perfecting knowledge in certain lines that would lie dormant were it not for the intense interest they take in this work, and their labors are to be encouraged by every founder. The good that such men as Dr. Moldenke renders to founding, illustrates wherein a metallurgist or chemist may be independent in dividing responsibility with the foundry superintendent or foreman in obtaining good castings and still often be the man of greatest value to the concern. The idea that a metallurgist or chemist, to be of any value or best placed, should divide the responsibility with a foreman is a false one.

While we may at times think that our individual researches have been the means of greatly advancing the metallurgy of cast iron, it is to be remembered that the greatest part of our present knowledge of cast iron has taken years to create. The editorial which this article criticises would lead the inexperienced founder to think that the metallurgy of cast iron was something new, a science just being introduced, and hence called for a subdivision of interests, experiences and management, when the truth of the situation is, metallurgy of cast iron is as old as founding itself and about as inseparable from the actual work of melting and molding to make good castings, as are sunshine and rain to the growth of vegetation. To rightly discuss this subject we cannot consider metallurgy of cast iron as being recently developed. The factor to be recognized is that past experiences and advance knowledge has accumulated to such a stage as to exact increased vigor at the hands of the molder and founder to keep pace with its progress, and those that love the trade will not permit themselves to be laggards to fall back in the race. Those that do will, in a few years, find themselves nonentities, as far as being considered capable to assume the responsibility of managing a foundry.

To keep pace with present progress does not demand that molder, foreman or superintendent should be a trained metallurgist in the college sense of the term, as a chemist qualified to analyize irons. For general foundry, a knowledge of what iron analyses and the physical results such can and will give when remelted, is all that an experienced foundry superintendent or forman need know as regards making mixtures to be held responsible for the product of a modern foundry.

Any founder that has labored to keep abreast of the times, knows that such knowledge is that which any founder or

molder can readily attain, if they will but labor to do so.

To know what changes different combinations of the metalloids may create in making mixtures, does not demand that a founder not up in the chemistry of mixtures must experiment for himself before he can have any knowledge of how to be governed by analyses. There is an abundance of valuable literature on this subject and which it can be said if studied will cause any founder to excel any metallurgist not experienced with founding in making and controlling mixtures by analyses to the end of making good castings. The best metallurgist that ever lived would be almost useless in a foundry to assume the responsibility for results of mixtures, did he not first learn the hundred and one peculiarities that are incident to melting and molding in effecting desired results in castings.

To learn these peculiarities he must go with the founder to investigate and observe the many ways in which the melter and molder can give different characteristic qualities to like grades of pig metal, etc.

The metallurgist's or chemist's part in aiding the founder can be made so independent of the action or responsibility in securing good castings, as that which the patternmaker, machinist or blacksmith plays in assisting the founder to complete his appliances for making molds. It would often be as reasonable to claim that the responsibility for making good castings should be divided with some patternmaker, machinist or blacksmith, as to split up with a metallurgist or chemist. Their value will not be lessened by being independent, as are the patternmaker, etc., and all metallurgists or chemists will be wise in maintaining independence of any responsibility for desired results in castings as long as they can.

Because recent advance compels new and extended research and study on the chemistry and metallurgy of cast iron, is no reason why the founder should be admonished to release himself of responsibility. Instead of this backward slide, the founder should be admonished and encouraged to increase his knowledge and skill the more to be a master of a trade that is to-day recognized and taken up by our most learned and brightest minds as one worthy their labor to fathom its intricate science and workings that afford man greater scope for the display of mechanical skill and judgment than any other trade of to-day.

The past few years' elevation and progress of founding has been of such a rapid growth that many have become so discouraged as to give up making any effort to keep up with its advance. Instead of this dropping back to let others take the lead, all trained founders that have any interest in the advance of their calling, should only the harder strive to hold the reins. No matter how high or swift the current of progress rides, the molder and founder that loves his trade will labor to fit himself as the best to be at the helm. As only one can be responsible for a ship's course, so is general founding best guided, and he that thinks to divide its responsibility to have two or more directors who shall control the methods for producing castings, is very liable to sooner or later drift to rocks of contention, distrust and final destruction of a firm's business.

CAST IRON NOTES.

Devoted to Inquiries from Practical Foundrymen on the subject of Melting and using Cast Iron. Address all Inquiries to W. J. KEEP, care of The Foundry.

HOW TO BECOME A FOUNDRY FOREMAN.

Question: I have been told that if I would ask you, you would be willing to tell me how to fit myself to become foreman of a foundry. I have a common school education, am eighteen years old, and like mechanical work.

Answer: A good foreman must know the best way to make every piece that comes into the shop. He must be able to have work done without any mistakes and with the least expenditure of labor. He must know as much as the men who do the work if he is to have their respect. The foreman is usually selected from the molders employed, and has never had an opportunity to gain as much information as he needs. Whether a foundry makes or looses money depends upon the foreman. If a casting is defective the work expended upon the mold, the cost of melting the iron and all labor expended upon it is a dead loss, whether the loss was occasioned by poor judgment in making the mold or in filling it with iron, or if the quality of the iron was not suited to the job; in any case the foreman should have prevented all mistakes and should have caused the casting to be saved.

Founding at first glance does not seem to be an attractive business, and for this reason it is difficult to induce young men having the best talent to stick to the business long enough to thoroughly master it.

If they would stick to it there are plenty of places for men who are prepared to become foremen.

Conditions now are not at all what they were when men of to-day began to learn founding. Thirty-five years ago there were no trade schools and boys were required to pay a bonus of one or two hundred dollars for a chance to learn a trade.

To succeed in the future to the fullest extent a young man should have a thorough technical education and should understand each branch of the business that he engages in better than any one who is under his supervision.

Most young men who start out with the foundry business in view turn into some other line because it is more agreeable than founding.

But to answer the question.

A young man can serve a four years' apprenticeship in a molding shop and then work in other shops for four years more, and if he employs his evenings learning drafting, if he has the natural ability to direct others, he might be placed in a position where he could assist the foreman. In time he could learn to melt iron to make castings of required quality, but in the end he would only know this one line of business.

Another way is to get work for six months in a foundry, any work that will take him among molders. He will find some one who will be willing out of work hours to explain the things that he does not understand.

A couple of months in the pattern shop is very desirable. This will give a general idea of foundry work. The way to get such a chance is to work without pay. This is the key for getting information.

Now enter a school of mechanical engineering. The short shop experience will show how to apply the theory, and before the course is completed the young man will have gained nearly as much knowledge of blacksmithing, patternmaking, machine design and construction, and of foundry work, as he would by serving an apprenticeship of three years at each without the engineering course.

In other words, four years has made him a mechanical engineer and a good draftsman, with a fair knowledge of at least four trades, equal to more than ten years of pure shop work. He can take any position that offers. When he selects the specific line of work he is to follow, it will take hard work and close attention to acquire shop experience, but he will learn it ten times faster than he would without the education.

I have seen quite a number of men start for such a preparation for foundry work. Very few of them have entered the foundry, but the few who have have been very successful.

Among the Foundries.

The Nashua (N. H.) Iron and Brass Foundry is being enlarged 45x50 feet.

R. D. Wood & Co., Millville, Pa., are shipping cast pipe to Dublin, London and Egypt.

The Medina (Ohio) Hollow Ware Works, absorbed by a trust, closed down.

The foundries of Albany, N. Y., are overrun with work.

Robert Wetherell & Co., Wilmington, Del., will erect a new foundry, 140x65 feet.

E. Lander & Bros.' Brass Foundry, 294 Monroe street, New York, was burned.

The Century Foundry, Dighton, Mass., has closed for an indefinite period.

The old Rogers Foundry, Bellville, Ill., will be started up September 1.

The Pipe Foundry, at St. Thomas, Ont., burned. Loss $10,000; no insurance

The Jenckes Machine Works, Sherbrooke Que., burned. Loss, $225,000; covered by insurance.

The old Macon Machine Shop and Foundry, at Macon, Ga., is shortly to be put in operation.

The dull season in the stove trade is ended and the stove foundries are all starting up with a rush.

When completed the Perkins Foundry, Amsterdam, N. J., will be 50x100 feet, three stories high.

The Cleburne (Texas) Foundry and Machine Shops burned; value, $3,500; insurance, $2,000.

Golden's Foundry, Augusta, Ga., is being enlarged and improved to meet the demand for rush of work.

The New York Air Brake Co. will build a new foundry, increasing their force from 500 to 600 hands.

The Bussey & McLeod Stove Works, Troy, N. Y., start up, with 200 men, after four months' shut down.

Bridgeford & Co., Louisville, Ky., have built a new foundry. They will also erect a new, large warehouse.

The Kelley Foundry, Texarkana, Texas, was destroyed by fire. Loss about $2,500, fully covered by insurance.

The new addition to the Steel Casting Co.'s plant, at Chester, Pa., has been started. It will be 90x177 feet.

The molders at the junction foundry, Worcester, Mass., get the union scale of wages, because they insisted on having it.

The Kerr-Murray Foundry Co. has established a chemical laboratory in connection with its foundry, at Fort Wayne, Ind.

Joseph W. Vescelus, assistant superintendent, foundry, Dodge Manufacturing Co., Mishawaka, Ind., was killed by the cars.

The K. H. Porter Co. took out a permit to erect a new foundry corner Forty-ninth street and Allegheny R. R., Pittsburg, Pa.

The foundry and machine shops of Aaron Wissler, of Brunnerville, Pa., were destroyed by fire; loss, $10,000. No insurance.

Chas. A. Weidner, of Chester, Pa., died. He was a pioneer, and formerly conducted what was then known as Weidner's Foundry.

The Buffalo Stove Repair Foundry was damaged to the extent of $400 by fire. Edward Walter and Matthias Long are the owners.

The General Electric Co.'s Works at Lynn are booming, and additional buildings for the steel foundry department will be erected.

A $150,000 foundry will be erected at Ensley, Birmingham, Alabama, in connection with the million dollar steel plant now being erected.

Mr. Hurd Muns, of Cowlesville, N. Y., died in his 91st year. He cast the first car wheels that ran between Buffalo and Niagara Falls.

Wm. Resor & Co.'s Stove Foundry, Cincinnati, assigned. It was an old-established business, and they owned a large amount of real estate.

Bids for a range-finder tower, according to specifications, to be erected at Fort Hancock, ranged from $2,878 to $7,000! A little difference of $4,000.

The Waterbury-Farrel Foundry and Machine Company are tearing down an old building and erecting in its place a new four-story brick building.

Heinlen's Foundry, Burlington, Ia., was wrecked by flood, the building being overturned and sand, flasks and other property swept away; $1,000 loss.

The Torrance Malleable Iron Company, Green Island, N. Y., has displaced the cupola by an air furnace, and will heat the annealing ovens by oil fuel instead of coal.

Fire destroyed the machine shop and part of foundry of The Brunswick Machine Manufacturing Company, Brunswick, Ga. Loss, estimated at $50,000; insurance, $20,000.

The reorganization of the Bass Foundry and Machine Works, Fort Wayne, Ind., involved the employment of fifty revenue stamps, valued at $50 each, amounting to $2,500.

The Chattanooga Car and Foundry Co., also the Ross-Meehan Foundry Co., of Chattanooga, Tenn., are crowded with work; the latter having been compelled to build a large addition.

The strike at the Muncie (Ind.) foundry and machine shops is settled by the firm paying the rate of wages demanded by the men, which involved an increase of 25 cents per day.

New buildings and extensive repairs are being made at the Warder, Bushnell & Glessner Malleable Iron Foundry. The company starts on the largest year's work in its history.

Personal property to the value of $11,000 in the Peckham Foundry, Utica, N. Y., was sold under execution of judgments in favor of the Oneida National Bank, which bid it in for $5,000.

Tandon H. Boutell, of Nashua, N. H., for over 30 years superintendent of the Flather Foundry, has accepted the position of superintendent of the New Home Sewing Machine Works Foundry.

A Bangor, Me., foundry has just quit business for good, having run since 1842. It made the first saw mill used at Falls of St. Anthony, Minnesota, but the Western works have knocked the old patriarch out at last.

Mr. James Flockhart, of Maher & Flockhart, founders, Newark, N. J., while riding his wheel collided with a wagon and was badly injured. Five stitches closed the scalp wound, and he was removed to his home.

The large new foundry of Bridgeford & Co., Louisville, Ky., is ready for occupancy, and the old one, which has stood for nearly seventy-five years, has been removed, to make room for Illinois Central Railroad switch yards.

The Hardie-Tynes Foundry and Machine Company, of Birmingham, Alabama, has been awarded the contract for the building of a huge duplex air compressor for the Sloss Iron and Steel Company, to be used in the new ore mines at Leeds.

C. A. Burgess sold his interest in the Burghart & Burgess brass foundry, Pittsfield, Mass., to J. H. Burgess, and the business will continue without change of name. Mr. C. A. Burgess takes the position of physical director of the Y. M. C. A. at Bennington, Vt.

At the works of the St. Louis Steel Co., at Granite City, Ill., a large iron shaft fell into a large ladle of molten metal, splashing the metal out and badly burning five men. Walter Irwan (colored), one of the unfortunate men, has since died as a result. He leaves a wife and several children, at 402 South Fifteenth street.

Wm. T. Shephard, for the past three years secretary for the Sessions Foundry Co., has resigned. George M. Eggleston, an employe of the company, has been elected to fill the vacancy. Mr. Shephard will engage in business at his former home, Buffalo, N. Y. Also, Mr. Wm. H. Stafford, foreman of the foundry at the same place has resigned.

Fifteen tons of molten iron exploded at the foundry of Wm. Todd & Co., Youngstown, Ohio, setting fire to the building. The workmen, knowing that the mold, a fifteen-ton cylinder, had been wetted by recent rains, expected the explosion, and so got out of the way before the iron went shooting through the roof. The fire company extinguished the flames before the roof was consumed.

The Star Foundry & Machine Works, Atlanta, Ga., owned by W. H. Camp and H. P. Moores, is the subject of an application for a receiver. Moorees and his friends, who represent the money part of the business, ask for the receiver, and Camp, the practical, experienced partner, claims that the business is solvent, and that it is running now at a profit. They built and moved into the present foundry during the past summer.

The Leechburg Foundry & Machine Co. will remove from Leechburg, where the business was established in 1885, to Pittsburg, Pa. They will occupy six acres of land, having 200 feet river frontage, and perfect access to all railroads. They have been employing about 150 men, but expect to double this in the near future. They make rolls, rolling mill and tin plate machinery of all kinds, and will engage in the manufacture of machine molded gears and steel castings.

Warrants were served on a number of prominent manufacturers of Harvey, Ill., for a violation of the State law prohibiting the employment of child labor. Members of the following firms gave bond before Judge Eberhardt for future hearing. The Harvester King Manufacturing Company, T. C. Austin Manufacturing Company, The Buda Foundry and Manufacturing Company, and the Bellaire Stamping Company.

Bloze and Skabbz and Kemistury in the Fowndry.

Mr. Editure:

I hev ben a reedin ov yure maggyzeen for ny onto a yeer and Ile be dad blastid if they haint sum ov the blaimist krancks a shutin off thire mouth on subjicks that haint gott no mower to do with the fwoundy traid than Bil Sykes haz. wich bil syks peddilz turbakkior an tarr sope. hee haint gott only 1 laig it was cutt of in a ralerode aksidunt. Them fellers is tawkin about sillycon and sulfer and fosforus and magnesia and so fourth in the iern and sez thay maik a big differ in the quollity ov the castin. They putt me in mind ov a lot ov hens a kakkelin. Enny darn fule can tel them that fosporous wil bern up in 2 jerks ov a lams tale if you dont keep it under wotter, and sulfir is what thay used to putt on the end ov matches becaws it berns ezy i dont no enny thing about sillycum, but if sulfer and posfurious bernz so quick wat in the name ov kommon sents wil it do cum to git it in a ladil ov meltid iern. Grate Skot why dont you git sumboddy that noze sumthin to rite about wots the matter with bad kastins i hev ben a

moldin now in ait yeers and i hav dun the akt in more than fore duzzen shops and thay is jest 2 kinds ov iern and i no it, and thats hard iern wich is 1 kind and soff iern is the other. but sum iern haz gott mour durt in than other iern but it haint posfer nor yet sulforus it iz jest plane dert.

Now, about bloze and skabz thay haint no use ov tawkin about them bekawz enny molder noze if yew doo yure werk rite thay haint a goen to bee none ov them, but if you reely want an artikle fum mi penn on this toppick ile wright 1 sum uther time. i can giv yew moer pinters on founderry practiss in 1 da than them windy doods in 6 weaks i spoze yew pa them fellers and if yew reemoonerait me for this i wil submit for yewer eckseptation an other editorioral by return male yewers az evver

tacks payer.

p. s. that is mi nom de plum

p. s. number 2 i Wil Putt more Kaptal letters in nex time if you think it wil look better. yoorz az evvur

t. p.

What is Semi-Steel?

By A SCOTCH FOREMAN MOLDER.

(All Rights Reserved.)

I have just read from your June number, page 133, an article on the above subject, and while indorsing in a general way its contents, I certainly do not admit that "it is nevertheless a fact that most of the so-called secret mixtures rely largely upon the ignorance of the foundrymen for success."

It is about ten years since I first tried the mixing of malleable iron or steel scrap in its varied forms, such as ordinary turnings, steel scrap or rails, cut up in pieces suitable for the cupola, although at the time referred to I had never seen or heard of such a metalloid, I was quite confident that the results would be satisfactory, since it was the case that all steels, however perfect, had to come from the pig metal in all its crudeness.

With the consent of my then old and respected governor, I began and the success of my first cast was so satisfactory to him, that he at once said, "This can be nothing short of semi-steel." A strange coincidence this must appear, when we think there is a distance of over three thousand miles from the center of your semi-steel controversy and the geographical spot from where I am writing.

But after all what does it matter what we call the metal in question, since it is admitted that the line of demarkation is exceedingly difficult to determine? No doubt every compound in metal must have its name, and as brevity is the order of the day, I rather think that semi-steel is preferable to the phrase "toughened cast iron." About the time of introducing this mixture to the foundry of which I have charge, I had occasion to meet an old Glasgow foreman, and, while talking to him in a general way on matters pertaining to iron founding, I took occasion to make mention of this especial mixture. Fancy my surprise when he told me that he had been working exactly on the same lines for about twenty years. Thus you see I was forestalled, and the chances are, in my opinion that the thing is as old as the hills, or at least since iron founding became a craft.

And now as to its adaptability for castings. For reasons which may be obvious I cannot give in detail the various articles for which it is suitable, however, it has been substituted by contractors for ordinary "Siemens-Martin steel castings," where the Siemens-Martin was considered too good, and yet a superior article to that of cast iron was required. Of course it is a metal which requires some skill to work it, as by its increased tendency to "draw" while shrinking, it follows that in disproportionate parts the cavities formed are intense, unless otherwise provided for. I have never had any fixed rule as to proportions as it is largely a rule of thumb business, but I have never had results commendable when I exceeded two to one, that is to say, two parts of good Scotch pig and scrap combined to one of malleable scrap or steel as before mentioned. I have likewise used it as low as ten to one for a certain class of work, which had the desired effect.

With regard to the charging of this compound in the cupola, such can only be determined by the weight or quantity desired to be melted, however I would say in the first place, fill up with coke a little further above the tuyeres than which is required for an ordinary cast iron cast. Allow this to be thoroughly kindled before charging. Then put in the first charge of scrap and pig metal, next to this the coke charge, and afterwards the steel or malleable scrap. This order of

charging to be observed from first to last during the whole time of melting. With one or two shovels full of charcoal blacking on the bottom of the cupola and the cast iron charge melting first, such makes a splendid bath to receive the malleable or steel, which melts in turn, thus completing the alloy. Whatever amount may be wanted care must be taken that the entire melting shall be tapped into the one ladle, although such may have to be gathered from several tappings.

Kilmarnock, Ayrshire, Scotland.

Manganese in Cast Iron and Some Experiments Thereon.*

BY GUY R. JOHNSON.

It is not the writer's intention to present a lengthy paper on the theoretical aspects presented by the alloy of manganese with cast iron, but rather a brief account of some experiments which seem to indicate that further commercial use may be made of high manganese irons.

For the sake of greater clearness, it may be well, however, to recapitulate a few of the distinctive characteristics of the metal, as follows:

Manganese is a white metal, specific gravity 8.01, as against about 7.80 for iron; an atomic weight of 54.8, as against 55.88 for iron; will combine in almost any proportion with iron; oxidizes so readily that in its present state it cannot be exposed to the air without being changed to the state of an oxide. It has a great affinity for sulphur, and to put high manganese iron in the cupola when there is trouble from sulphur, is one of the most effective methods of getting rid of the sulphur, which goes off in the form of manganese sulphide in the slag. It possesses the property when in combination with cast iron of allowing the absorption of more carbon, i. e., the theoretical maximum of total carbon being in cast iron about 4.50 per cent, and in some ferro-manganese something over 6 per cent. Moreover, manganese certainly tends to increase the carbon in the combined state, or, in other words, to make the iron harder. This fact has long been known to the makers of car wheels, rolls, etc., but even they have apparently been more or less afraid of the element, for whenever in the technical papers, on the subject, anything favorable is said, it is with the proviso that, not over one per cent should be allowed. It is rather curious that this prejudice should have sprung up, because, as Anglo-Saxons, the first irons we knew much about, were the English and Scotch brands, and there are sure to be plenty of members at this meeting who remember well the day when it was thought by many shops to be impossible to make good, soft castings without the use of a proportion of "Scotch pig."

Now, let us glance at the analyses of some of the more famous brands:

Name.	Si.	Su.	Phos.	Man.	G. C.	C. C.	Grade.
Summerlee	2.70	.010	.55	1.80	...	..	1
Summerlee	2.47	.015	.76	2.51	...	..	1
Summerlee	3.44	.015	1.00	1.70	...	..	1
Summerlee	2.70	.020	.81	2.90	...	..	2
Eglinton	2.15	.025	.62	2.80	...	..	1
Coltness	2.59	.010	.84	1.70	...	..	1
Carnbroe	1.70	.008	1.10	1.83	...	..	1
Glengarnock	3.03	.010	1.20	2.85	...	..	1
Glengarnock	4.00	.010	.9	3.41	...	..	2
Coltness	3.50	.02	.98	1.56	3.30	.20	1
Langloan	2.93	.04	.75	1.62	3.40	.46	1
West Riding of Yorkshire	1.70	.07	.36	3.60	3.42	.58	1
West Riding of Yorkshire	1.60	.07	.64	1.50	3.16	.58	2

Note.—I wish to acknowledge my indebtedness to Messrs. Wm. Kent, C. A. Meissner, and A. Vosmaer for above analyses.

Does this look as if manganese was a deleterious element? Our predecessors certainly turned out good work, and just as certainly they used in many cases a high manganese iron to do it. Furthermore, our English cousins, who run neck and neck with us in the production of castings of all sorts, are using just these brands to-day, and are doing as good, or better, work than ever with them. In short, it would seem that our foundrymen should use more manganese, rather than less, especially if they want to use much scrap, and want to remelt, for manganese protects pig iron by absorbing sulphur and oxygen, thus rendering several remeltings possible.

It was while making a high manganese iron, i. e., 2.50 to 3 per cent, that the writer was led to make the experiments which follow, and which may, it is hoped, prove the starting point for practical work along these lines.

Our ordinary method of sampling the cast iron as it runs from the furnace, is to pour a small chill every three beds, cool, break in two, and take equal portions of the drill-

*Paper read at the Cincinnati meeting (June, 1898) of the American Foundrymen's Association.

ings from each, these drillings being then thoroughly mixed, to get as nearly a perfect average analysis as possible.

With ordinary iron of the same silicon contents, 1.50 to 2 per cent, and manganese of about .80 to 1 per cent, these samples can be cooled with safety, and very rapidly, as soon as they reach dark cherry red, or blue heat. We found it was impossible, however, to treat the high manganese iron in this way, because it was made so hard that not even mvset steel would drill it.

To test this the writer sent some samples to Dr. Henry M. Howe, for testing as to hardness, by his method of scratching with a diamond point. The results follow, with analyses appended:

HARDNESS OF SPECIMENS NOS. 10, 11, 12, 16, 17 AND 18, FROM GUY R. JOHNSON. FOUR MEASUREMENTS ON EACH OF SIX SCRATCHES, OR IN ALL 24 MEASUREMENTS ON EACH SPECIMEN.

	Razor.	No. 11	No. 10	No. 12	No. 16	No. 17	No. 18
Hardness, maximum	1.40	2.49	3.51	2.95	3.18	3.58	4.75
Width of scratch, minimum	1.08	1.41	1.54	2.03	2.17	2.13	2.62
Average	...1.233	1.84	2.343	2.400	2.700	2.865	3.580

	Si.	Su.	Phos.	Man.	C.C.	G.C.
1321.....	1.44	.01	.178	3.68		
1335.....	1.44	.009	.207	.88		

A glance at the table shows that the nigh manganese iron is very much the hardest.

The next question was: What practical use can this be put to?

As there was at that time a discussion going on as to the relative value of various brake shoes, the writer determined to test the high manganese iron with a view to getting an iron that should be at once hard, yet not so hard as to wear the wheel too much, and at the same time should be tough.

The following are the results of the experiments, and while they are incomplete, yet they afford a basis for future work along the same line by members of this association who have more opportunity and time for such work than the writer.

Experiment first—Brake shoes, Christy pattern, run direct from furnace, and cooled, respectively, one at red heat, and one at blue heat, and one unchilled. N. B. All tests were made by putting the brake shoes concave side down on the table of a 50,000 pounds testing machine, and pressing down till the point of breaking was reached, as per sketch.

Cast No. 1322, direct from furnace.

Si.	Sul.	Phos.	Man.
1.22	.011	1.85	3.61

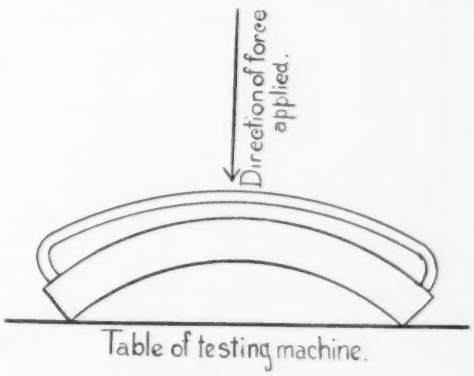
No. 1 chilled at red heat, broke with considerable toughness, i. e., no sudden snap, at 14,600 pounds.

No. 2, blue heat, defective.

No. 3, unchilled, broke at 15,300.

Fracture in all these open and with some flaws.

Naturally, this was not satisfactory, so to establish a standard, a mixture of our strongest iron, giving tensile results of about 25,000 pounds, was used, and the experiments transferred to the foundry. The special iron, or "machinery iron," as we term it, brake shoe, with an average analysis of:



Si.	Sul.	Phos.	Man.
1.25%	.020	.189	.75

gave results as follows:

Chilled at red heat, defective, cracked.
Chilled at blue heat, sound, 25,650.
Unchilled, sound, 21,500.

The chilled shoes, however, broke with a sharp snap, showing no toughness, but great transverse strength.

Test No. 3. Cast No. 1316:

Si.	Sul.	Phos.	Man.
1.96	.024	.189	2.32

Melted in foundry—
Cast against chill plate, 21,000 lbs.
Chilled at red heat, 19,500 lbs.
Chilled at blue heat, 23,600 lbs.
Unchilled, 22,600 lbs.

Several other tests of the same cast showed that the high manganese iron chilled at blue heat gave uniformly the same results. The pieces chilled against an iron plate were kindly tried for the writer by

the Southern Railroad, but while showing toughness, were too soft.

The shoes chilled at red heat were too brittle, and so hard that they could not be touched with a drill, which of course, indicates they were too hard for practical use, but those chilled at blue heat showed greater toughness than the ones made of our strongest iron; although not so strong, they drilled with great difficulty, and the resultant drillings were very fine--nothing more than powder, in fact. Unchilled, the shoes were much too soft.

In short, the sum of the results seemed to be that very great hardness, with good strength and toughness, might be obtained by using high manganese iron and chilling at blue heat.

Dr. Howe's experiments show how much harder than ordinary iron this alloy is, and it is sincerely hoped by the writer that practical use can be made of the idea.

A Test for Determining the Hardness of Cast Iron.*

By CHAS. A. BAUER.

Inasmuch as none of the previously known methods for determining the hardness of cast iron had proven to be practical for a number of reasons, foremost among which was the impossibility of duplicating the results obtained, which was sufficient in itself to demonstrate that the method in question was unsatisfactory in character, it became imperative that some method be devised that would be simple and yet reliable, and which would contain none of the objectionable features which are known to exist in other methods.

As the previously mentioned tests were merely superficial, dealing solely with the character of the surface of the metal, which is no indicator of the nature of the material beneath it, we can readily see at what a loss any manager must be who depends upon such tests to control the hardness of his castings. Since the everyday use of these tests was impractical, the physical characteristics of the foundry products was determined by inquiries directed to the heads of the different departments where machine work was done. The results obtained in this way being conflicting, and in many cases contradictory, made it necessary to inculcate into the new method mechanism which was absolutely automatic, in order to eliminate any possibility of personal equation entering into and affecting the results of the tests.

From the fact that a drill running at a uniform rate of speed and under a constant pressure, the number of revolutions which would be required to drill a given depth would be directly proportionate to the hardness of the material being tested, it was deemed expedient to formulate a method along these lines.

An ordinary drill press was equipped as follows: On the pinion shaft, which raises and lowers the spindle, is attached a disc twelve inches in diameter, around the periphery of which is placed a light flexible wire cable, on the end of which is suspended a weight which maintains a constant pressure upon the drill. The standard drill is now placed in the chuck. The drill spindle has a revolution counter, and by means of magnets and an armature is controlled by the position of the drill in relation to the table. All adjustments are made so that the revolution counter is thrown into gear after the point of the drill is entirely embedded under the surface of the test piece, and out of gear when the spindle has descended from this point exactly one-half inch.

When the test is to be made the test bar is placed upon the table and the drill is brought down upon its surface; the feed lever is then unlatched and everything is ready for the test. The drill is now rotated at a speed of 250 revolutions per minute, and the hole drilled. The revolution counter is electrically thrown into gear after the drill point is buried beneath the surface, and out of gear when the one-half inch from this point has been reached. The reading of the revolution counter now gives us the exact number of revolutions required to drill the one-half inch, and this we term the degrees of hardness. The more revolutions required the harder the casting; slight variations in hardness being easily detected.

We have adopted, and would recommend as a standard, a $\frac{5}{8}$-inch flat drill having an angle between its cutting edges of 120 degrees and a clearance angle of 10 degrees, running at a speed of about 250 revolutions per minute and having a constant pressure of 160 pounds.

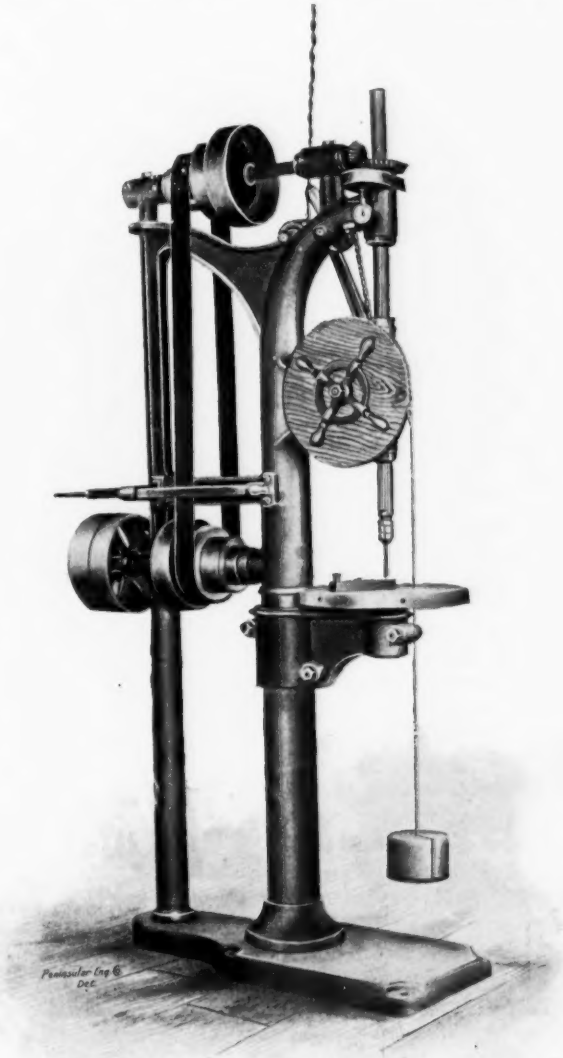
A flat drill has been adopted on account of the facility with which it can be ground to the proper angles. The cutting angle may

*Paper read at the Cincinnati meeting (June, 1898) of the American Foundrymen's Association.

vary between 115 degrees and 125 degrees without affecting results, but the clearance angle should be ten degrees. The revolutions of the drill may vary between 240 and 260.

The pressure of the drill should be as near 160 pounds as possible in order to compare with results obtained elsewhere by this method, and should be determined while the drill is in motion. We have placed a small platform scale upon the drill table, then placed the test-piece on this scale and found the pressure to be 160 pounds while making a test.

After the apparatus has been prepared and standardized, it is well to determine the hardness of a long test piece, which should then be put away and preserved as a standard. Any changes which may then take place can be entirely eliminated and results reduced to the standard by the formula,



MR. C. A. BAUER'S APPARATUS FOR DETERMINING THE HARDNESS OF CAST IRON.

$$\text{Degree of Hardness} = \frac{Dr}{R},$$

in which D = the degrees of hardness of standard test piece; R= the number of revolutions of drill required to drill that piece under present conditions, and r=the number of revolutions obtained in drilling the piece.

the hardness of which we wish to determine.

We make daily tests of our cast iron and mark each piece with its determined degree of hardness, and use any one of them to determine the change in the drill.

We have selected four test bars which represent four grades of hardness. Castings for our purpose should range between that determined for Bars Nos. 2 and 3; No. 1 would be considered too soft, while No. 4 would give us trouble in the machine shop and would surely bring in complaints. We repeated the hardness test on each bar, obtaining three results for each bar. We herewith submit results of these tests:

Bar.	Hardness.		
No. 1	130	128	129
No. 2	150	149	149
No. 3	170	168	167
No. 4	236	232	230

The greatest variation of results occurred in the drilling of the fourth bar, where it was less than three per cent. We therefore believe that we have a reliable test and one that will prove of great practical value to all foundrymen.

A Talk on Brass Founding.*

By CHAS. VICKERS

Brass founding, like most other trades, naturally divides itself into classes. One foundry makes a specialty of plumbing goods, another of chandelier fittings, while another will devote itself to making machinery castings generally.

Plumbing goods comprise, as the name signifies, all brass goods used by plumbers, such as faucets, waste cocks, ferrules, etc.

Yellow brass is the metal generally used, and the work is of such a character that the patterns can be carded, namely, attached to match plates or boards, or else "gated," that is, a sufficient number of patterns to fill the standard size of flask, are riveted or soldered to the gate, practically forming one pattern. Both "plate work" and "gate work" have their own individual spheres of usefulness, but the writer believes, from his own experience, that it is better to put the patterns on plates in preference to gating them, whenever it is possible to do so. Bibs and cocks with their component parts, such as plugs, handles, stems, etc., and globe and other valves the parting lines of which are straight can be all made by the match plate system, thereby saving the time that would be expended in making matches, trimming the joint of the mold, etc., as is necessary with gated patterns.

In order to turn out this class of work to the best advantage, first-class flasks should be provided and kept in good condition. Interchangeable flasks are almost a necessity on plate work, as the plate must fit on the pin halves of flasks, which are used as nowels.

A yellow brass called dipping metal is generally used for chandelier castings. This

CHAS. VICKERS.

class of work is mostly light and ornamental in character. Much of this work is skin dried by spraying with gasoline and then burning off.

There is quite a knack in pouring, as the metal must be thrown into the mold with force enough to run, and at the same time not strain the casting.

No branch of the foundry business calls for more individual skill on the part of the molder than that of machinery brass work.

Not only must the workman be equally at home on floor or bench, but he must be prepared to turn out castings in a dozen

*Paper read at the Cincinnati meeting (June, 1898) of the American Foundrymen's Association.

different alloys, each of which has its own peculiarities in changing from the liquid to the solid state, which peculiarities must be humored in the construction of the mold, or trouble will ensue.

Some alloys, as for example phosphor bronze, require the mold to be rammed more than ordinarily firm, while in the case of aluminum bronze we must go to the other extreme and ram it exceedingly soft, so that the mold will not resist the excessive contraction, otherwise the casting will be drawn apart.

Phosphor bronze shrinks but little, but if poured too hot it will eat into a green sand mold almost like water; to prevent this it is poured cold into such molds. It can, however, be poured hot, provided the mold is well coated with plumbago, and then baked before casting.

Chain guards for ladies' bicycles are a class of work that sometimes cause a great deal of trouble. They are made of aluminum and the trouble is caused by their cracking. After repeated trials, one firm with which the writer is acquainted, made them successfully by soft ramming, gating them with two broad, thin gates on the sprocket wheel end, and elevating the sprue end six inches.

The metal was thrown in at a dark red temperature, and immediately the copes were thrown off, while the metal in the sprues was yet liquid.

On small, loose jobbing work, when there is more than a dozen pieces required, it will pay to make "set" gates, as they save the time consumed in cutting and slicking the gates, besides producing cleaner castings. They are easily made as follows: Make a mold, cut the gate as required, leave the patterns in, close the cope and pour into the gate cavity tin at a low temperature so as not to injure the patterns if they are wood. Should there be any castings previously made from these patterns, draw the patterns and substitute the castings, before closing and pouring the mold.

In making heavy brass work it is advisable, whenever the shape of the pattern will permit, to pour from the bottom exclusively. Take, for instance, a brass bushing weighing, say, over 500 pounds. Suppose the pattern is 18 inches in depth, three or four feet in diameter and anywhere from 1½ to 2 inches in thickness and has a green sand core in the center. The casting had better be poured with two pots, and the gate at the bottom through runner cores. When the metal will impinge on the green sand core, a piece of dry core is built in to prevent scabbing. The runner which leads the metal from the joint to the bottom of the mold should be about one inch in diameter. From the joint up, through the cope, it is enlarged to between two and three inches in diameter, thus we get metal to feed, and keep the gate solid. A so-called skim gate is used in pouring. About four inches distant from the aforesaid runner with its riser, another runner cuts through the cope, to the joint; it is connected to the riser of the first runner by a horizontal channel cut in the cope. This channel must taper from the runner to the riser, like a nozzle. It is comparatively small at the junction with the riser.

Here is the point where care and judgment must be used. If it is too large it will take the metal too fast, making it impossible to keep the pouring head full, and the scum will enter the casting, showing up as dirt. If it is too small it will not take metal fast enough, and the casting may not run, as it is poured rather cool. When pouring, as the pots empty the stream naturally grows smaller, this is another point to be watched or the head may sink, and the whole of the bubbly scum be sucked into the mold. When the head is successfully kept full, this method of gating gives clean castings.

In order to feed and prevent shrinking in the casting, we have been considering it is prudent to put on a riser 3½ inches in diameter. It must not be put on top of the casting but about an inch away from it, anywhere where convenient, connected with the casting by a good deep gate, filleted so as to break off hot, without breaking in. Carry the feeder up four inches above the cope. When the mold is filled, cover the pouring head and top of runner riser with sand, bed on a weight, then fill up the feeder head. Shake out while hot, break off feeder and runners, and scrub the casting with a spade.

As the making of alloys of copper is a subject that has been ably and extensively dealt with by writers, and before this association, it would be only repetition to mention the same here, further than to remark, that it is very seldom that the practical metal mixer gets a chance to use wholly new materials. The scrap brass must be used up somewhere, and it is generally

cheaper than a new mixture. To use it judiciously is where the art of metal mixing comes in. The mixer must be able to judge of the quality of the metal in the different pieces of scrap as he sorts them out.

Bells, bearing brasses and bushings are, as all practical men know, generally hard brass. Car brasses justly come under suspicion, they are often made of old copper buttons and scrap containing iron. They must be used sparingly in finished work. Valves and small red brass scrap are generally soft, and may be used accordingly. Soft brass may be stiffened by the addition of hard scrap, and porosity guarded against by adding yellow brass scrap.

Scrap metal has a great tendency to make dirty castings; guard against this by cleaning the metal before pouring. Bring the metal from the furnace hot, add the new metal mixture. After stirring thoroughly scrape down the sides and bottom of the pot, inside, with the skimmer, which had better be of ⅝-in. round iron; stir again and skim off. If the metal is hot enough, there may be time to repeat the stirring and skimming. A surprising quantity of dirt is removed from the metal in this way. When pouring, bridge the lip of the pot with the skimmer, holding back all dirt. The writer has made key heads, scaling 30 lbs. each, with only 1-16 in. stock allowed on both sides for finishing, out of common scrap by using care as aforesaid, and not lost one out of sixty.

The Manufacture of Aluminum.

From an elaborate article on the manufacture of aluminum, by E. Ristori, in the Mechanical World, we extract the following:

Working of Aluminum.—With certain limitations, imposed by the chemical and physical peculiarities of the material, aluminum can be worked much like the other industrial metals handled at the present day. It is best melted in sand or in iron crucibles without the addition of any flux, at a temperature not greatly exceeding its melting point, 655° C. =1210° F. On a larger scale, the operation can be carried out at a dark-red heat on the bed of a reverberatory furnace lined with basic magnesia bricks of good quality. In casting, special precautions must be taken to allow for the great shrinkage during cooling. The molds should have large risers and plenty of vents. They are preferably cooled from the bottom upwards, to enable the gases to escape. Slabs for rolling must be cast in closed ingot molds with a perfect machined internal surface, which is coated all over with graphite and water. The molds must be very hot and the castings cooled quickly in very cold water to make them soft. Aluminum can be forged hot or cold; preferably at a temperature which causes a hard wooden stick to smoke when pressed against the metal. In comparison with other metals, it ranks third in order for malleability and sixth for ductility; sheets have been hammered as thin as 1-40000 in., and wire can be drawn down to 1-250 in. diameter. No lubricant should be used for rolling; and the aluminum requires frequent annealing at a low red heat just visible in the dark. In turning, the edge of the tool soon becomes blunt, unless only small cuts are taken.

In making bronze castings, the metal is not poured straight into the mold in the usual way of casting iron, but into a runner box, or for large castings into a number of runner boxes, having holes in the bottom corresponding with the gates of the casting. During the time the metal is being poured into the runner box, these holes are filled with iron plugs until all the metal is in the runner box; the plugs are then taken from the holes, so that the metal runs into the gates of the casting from the bottom of the runner box, and leaves the scum behind in the box, or in the top of the gates. In making castings of aluminum, it is not sufficient to use runners of the same size as those usually employed in making brass and iron castings. As the shrinkage of aluminum is about three times the shrinkage of ordinary gun metal, a considerable amount of trouble is experienced if the runners and risers are not large enough to allow the casting to continue to be fed during its shrinking by the runners or risers connected with it.

One of the largest uses to which aluminum has been applied is in metallurgy, where its valuable metallurgical properties were discovered and utilized. It is common knowledge among steel makers that ingots often turn out spongy at the top; and when particularly good ingots are required, the faulty portion is cut off and melted over again. By the introduction of a very small proportion of aluminum to iron, steel or brass, either in the mold or in the ladle, the founder can be quite certain that the ingots will be solid all through. When used in this way, aluminum has the peculiar virtue of instantly liberating

all the gases contained in the metal, and of keeping it fluid for a longer period, so that by the time the casting solidifies the gases have had an opportunity to escape. In almost all steel works, and in all the principal foundries, aluminum is now being employed; and reports from some of these state that the result is a reduction in the wastes by 80 or 90 per cent. In this case alumimum does not actually replace any other metal, but by its own special qualities is useful as a means of improving physically and chemically some of its older rivals and friends.

Foundry Practice

And the Use of Low-Grade Irons as a Substitute for Scrap.

Foundrymen, as a general rule, have been in the habit of purchasing No. 1 pig iron, which had a fracture showing very open grain, irrespective of the chemical composition of same. It has been, and is yet, to a considerable extent, the prevalent belief that the more open the grain of the iron, the larger the quantity of scrap it will carry; but in practice results have in many cases proved this to be incorrect, and the capacity of pig iron as a scrap carrier can only be determined by the silicon contained in same, and even with this knowledge it is hard to determine with any certainty what percentage of scrap should be added, on account of the variable quality of scrap in general. It is true that an open grained iron, if it contains in suitable portions silicon, phosphorus, sulphur and manganese is an ideal iron for foundry use, and more especially for work that has to be machined, on account of the high graphite and low combined carbons, but unless supplied with above ingredients, in limited proportions, results will prove unsatisfactory.

In our extended experience in aiming to satisfy the requirements of our customers, we have shipped iron very pleasing to the eye of as bold and open grain as possible to make, which failed to give satisfaction; as a last resort we shipped a close grained iron, highly silicious, which gave entire satisfaction. Having received various complaints from our customers with regard to rough and dirty castings (they laying the fault to the pig iron), on making an investigation of same, we proved not only to our own but to their satisfaction as well that the trouble lay in the use of inferior and dirty scrap; to overcome this we suggested the use of the lower grades of iron as a substitute for scrap, and in the numerous foundries where this suggestion has been acted upon, entire satisfaction has been the result; in fact a great many foundries have dropped the No. 1 and use altogether our Nos. 2, 3 and 4, which permit the using up of foundry scrap made from same, and from these we are in receipt of numerous communications extoling this mixture on account of splendid results.

When we know the work for which our iron is going to be used, and have not to contend against all kinds of scrap, we aim to give a mixture sufficiently high in graphite, with a silicon suitable for softness, phosphorous enough to give fluidity, but not too high to affect the strength, sulphur low, and with manganese enough to prevent the absorption of sulphur by the iron during remelting. Each of these ingredients have, excepting sulphur, a beneficial effect upon cast iron until they reach a certain percentage; beyond the higher limit they prove detrimental in themselves and lead to bad results.

To one of our large customers we made a shipment of these lower grade irons (Nos. 2, 3 and 4) and are in receipt of a letter from them from which we quote as follows: "We have tried to-day the second melt from your iron; we put in equal parts Nos. 2 and 3 and one-fourth No. 4 with 25 per cent scrap, and we had a nice running iron. To-day we put in the same of pig and 50 per cent of scrap and 5 per cent of Scotch ferro silicon, and we had a nice running iron and strong. The first melt was not strong, but to-day it is strong iron and has a good face."

Yours truly,

SAMUEL PARK.

Fluor Spar in the Foundry.

The advantage of the fluor spar as a flux in foundry work does not seem to have been recognized as it should in the United States. In English foundries the use of fluor spar as a flux is very common. It may be that the uncertain supply in the United States has prevented its more general use, but with the opening up of new and more workable deposits, which will be referred to later, there need be no difficulty in securing the mineral in whatever quantities are needed.

At the present time fluor spar is used more extensively by the manufacturers of chilled car wheels than by any other branch of the

foundry trade. While in making chill rolls an air furnace is used and no flux is required. When limestone is used in the cupola its function is merely to slag off the ashes of the fuel. It has no important chemical action on the iron, excepting the unfortunate one of tending to slag the silicon. Fluor spar accomplishes the same purpose as limestone in fluxing off the ashes, and does it with a considerably smaller quantity, thus favorably affecting the melting ratio, while in addition it has an important effect on the iron. Dr. Foehr, a noted German chemist and metallurgist, in an article published in the "Chemiker Zeitung" some time ago, strongly urged the use of fluor spar in the foundry, pointing out that it keeps the iron gray and soft by holding the silicon as an alloy, at the same time tending to slag off some phosphorus and sulphur. It is important that just the right proportion of fluor spar be used in such cases. It has been found in some classes of work that the advantages decrease where more than a certain quantity of fluor spar is used, the best proportion being in certain cases only one-third of one per cent. In other cases as much as 5 per cent is recommended.

In the ordinary run of foundry work fluor spar constitutes a valuable flux, as it makes the iron run much more freely than limestone, permits the use of lower grades of iron, and allows a much larger quantity of scrap to be melted with facility.

For many years back, and until comparatively recently, practically the whole supply of fluor spar in the United States was obtained from deposits located in southern Illinois. Local conditions have been such that some uncertainty was experienced in obtaining a regular supply, the roads being much cut up in wet weather, and the mines frequently filling with water. Lately it has been found that there is an extensive deposit of very pure fluor spar in Kentucky. Fluor spar is the raw material in the manufacture of hydrofluoric acid, which has of late been introduced to the foundry trade for cleaning castings, its action being to dissolve the sand, rather than loosen it by dissolving the iron beneath, which is the manner in which sulphuric acid acts. In order to secure a steady supply of high grade fluor spar for the manufacture of hydrofluoric acid, James Irwin & Company, manufacturing chemists of Pittsburgh, Pa., recently secured control of the main deposit of fluor spar in Kentucky, forming the Kentucky Fluor Spar Company, of which they are sole agents, to work the mines. They are now putting the material on the market in different grades, as desired for foundries and others who require the material, and are in position to guarantee prompt and regular shipments. It analyzes from 94 to 98 per cent pure fluoride of calcium. For glass manufacturers and manufacturers of enameled ware, such as bath tubs, etc., the mineral is closely selected and ground to a fine white powder.

Management of Blast Furnaces—Transition From "Rule of Thumb" to Application of Scientific Methods.*

By E. S. COOK, Pottstown, Pa.

INTRODUCTION.

In discussing this subject the object sought may be best attained by giving an account of my own experience rather than by treating it in a general way.

My first intimate acquaintance with the blast furnace dates from 1871. At that time it was generally believed that no one was competent to manage the practical end of blast furnace work unless he was "born in a tuyere arch." This expression was meant to imply that the mysteries could only be solved and handled by a man starting as a laborer and working up through the various positions pertaining to the stock-house and cast-house—first helper, keeper, and finally founder—involving an experience of five to ten years or more. The founders were men separated by the process of natural selection from their fellow workmen, possessing more than ordinary natural intelligence and good judgment, quick to meet emergencies, of some mechanical skill and close observers of blast furnace phenomena.

The managing partner, or business manager, as a rule, possessed little or no practical knowledge of making iron. He bought the material, ofttimes at the dictation of the founder, in whom resided the power to condemn or approve.

*A lecture delivered to third year students taking the course of metallurgy in the Schools of Mines and Chemistry, Columbia University, and reprinted from "School of Mines Quarterly," April, 1898.

The total product of the active furnaces during the year 1872 was about 2,500,000 tons. The product for 1897 nearly reached 10,000,000 (9,652,680 tons), while the total capacity of all the furnaces now erected is estimated at 14,000,000 to 15,000,000 tons.

This wonderful increase is due, in great part, to the application of scientific methods to the management of blast furnaces, the new method replacing the "rule of thumb" practice, or the system of guess work in which the furnace itself was the laboratory.

The discovery of Sir Henry Bessemer, and the introduction of the Bessemer steel rail, has revolutionized the traffic and transportation of the commercial and industrial world. Pig iron, however, is the basis of the steel manufacture. With pig iron costing from $25 to $30 per ton to make, it is evident that steel rails could not have been made and sold for less than one cent per pound. Better management of blast furnaces reduced the cost of manufacture, lower priced pig metal made cheaper rails possible, cheaper rails reduced transportation charges. These causes acted and reacted upon one another so that the world is now furnished with pig iron and steel in their various forms, at lower rates than were even conceived as being within the range of possibility.

This in turn has led to an increased use. Notwithstanding, however, the vast consumption, productive capicity is in excess of current demands.

A few enthusiastic young men happened, by chance or otherwise, to obtain control of the practical working of several furnaces.

They formed the nucleus of the new order of blast furnace management, and demonstrated that energy, close application to details, and untiring industry, together with a broader intelligence, capable of applying the teachings of chemistry, could profitably replace the old order, where guess work formed the foundation, assisted by shrewd observation and long experience.

The new method reduced the risks, but the improved results were only obtained by hard work and many disappointments and trials. We had to learn by bitter experience how to properly apply the analyses furnished by the laboratory, the manager, in most cases, being his own chemist.

Notwithstanding intense commercial competition, it is worth noting that the more intelligent and liberal-minded managers exchanged thoughts and experiences with the utmost freedom, so that these friendly meetings and friendly competitions to excel were largely instrumental in adding to the efficiency of each individual manager. Previous to 1873 metallurgical literature was sadly deficient so far as it related to the blast furnace. It was suggestive rather than instructive, and valuable to this extent. With the growth of the American Institute of Mining Engineers and the British Iron and Steel Institute, and following the Centennial Exhibition in 1876, the literature of the blast furnace rapidly increased. It now forms a valuable aid to all interested in the development of the business.

Intelligent management, with its improved results, brought with it a demand for better appliances, better equipped furnaces, different constructions, etc., so that the blast furnace engineer, practically unknown before, now became a feature. He gathered up the experiences of the various managers, became a medium of exchange, formulated, combined, suggested and devised many useful appliances, so that he assumed a position of no little importance.

It is rather a curious incident, however, that men trained as mechanical engineers did not become the most successful managers; a different bent or training of mind seemed essential.

THE BLAST FURNACE.

I will not refer to the theory of the chemistry of blast furnace operations, other than to remark that if it were a melting operation only, such as takes place in a cupola, it would be comparatively simple.

It becomes complex because of the chemical reactions, upon which depend the removal of the oxygen from the ores, and the mechanical difficulties that beset the descent of the materials, and the ascent of the gases of combustion through the column of descending solids.

It was not long after I became the manager of a furnace that I discovered it was one thing to criticise the actions of the founder after the event and quite another thing to have the sole responsibility and to foresee the result of a certain course of action.

Hindsight is the gift of the many, but correct foresight in blast furnace work, as in any other department of activity, is confined to the few. While great progress has been made by the present generation of blast furnace managers, there yet remains much to be accomplished. Not unfrequently I am

forced to confess how little I really know about the operations of a furnace and what little control I have over the process. In fact, after a practical experience of tweaty-three years, I realize more than ever before how much there is to be learned in order to perfectly control the operations of a blast furnace. Sometimes the furnace seemingly runs itself, moving along with the regularity of clockwork, which becomes almost monotonous, and then is followed by irregularities more or less serious, causing the manager a nervous strain and physical exhaustion, with a feeling of mortification at his apparent helplessness and of disgust that he knows so little.

A furnace seems to have an individuality. Two furnaces, side by side, fed with the same material and under the same management, may work entirely differently and demand different treatment to obtain good results, showing, in fact, the unaccountable differences that frequently characterize different members of the same family. There is a close resemblance between the profession of a furnace manager and that of a physician.

A furnace is always spoken of as possessing sex. Objects to which we become attached are idealized and we fondly refer to them as if they were of the same sex as the mothers, wives or girls we love.

Indications of the internal hidden working are the volume and pressure of blasts, the tuyeres, the slag, the escaping gases, the rate and manner of the settling of the stock on top, and the grade, composition and tonnage of iron produced. A cold top and a hot bottom are just as essential to a healthy furnace as a cool head and warm feet to the individual.

FLUXING.

Chemistry has simplified and rendered comparatively easy the fluxing of the earth; constituents of the various ores employed, plus the ashes of the fuel. In previous years this was the chief cause of trouble. Guesses were made as to the proper flux to be employed. Mistakes were followed by serious irregularities, such as high fuel consumption, worthless iron, and frequent scaffolds and occasionally the chilling of the furnace, involving heavy losses.

Fortunately there is considerable range, so far as safety to the furnace is concerned, in the composition of slag.

When a choice of material is possible the skill of the manager is displayed in making a combination of ores that will give the results desired with the least expenditure of fuel.

The most fusible slags theoretically are not the most economical practically, and in fact cannot be successfully employed in anthracite and coke furnaces.

Silicious slags, easily fusible, attack the brick work of the lining of the bosh. They become pasty above the line of fusion, frequently inducing scaffolds or arches, to say nothing of the evil effects upon the quality and grade of iron caused by the absorption of sulphur.

In proportioning the flux, care must be taken to provide for the removal of the sulphur of the fuel, as well as the sulphur contained in the ores. It is also conditioned upon the composition of the iron to be made. If the volume of slag is large per ton of iron a somewhat silicious slag can be depended upon to remove the sulphur, while if the volume of slag is small we are obliged to depend upon high temperature and basic slag to prevent the union of sulphur with the iron. The effect of sulphur upon the metal is to lower the grade and render it unsuitable for many purposes. Occasionally our slags contain 3 per cent of sulphur when in small volume, falling to 2 per cent when the volume of slag is increased, the grade and quality of the metal remaining the same.

Pig iron contains more or less silicon.

Upon the assumption that the same ores are used in making foundry iron of 2 per cent silicon considerably less limestone flux would be required than in making a mill iron of only 1 per cent silicon.

This is frequently overlooked. The character and quality of the iron made is influenced very materially by the fluxing.

There is less margin for variation in this respect than the mere working of the furnace alone.

The composition of the slag does not indicate either the grade or the analysis of the iron made. With slag of practically the same composition I have made No. 1 x foundry iron by fracture containing 3 per cent silicon with large crystallization, and iron of close grain with less than 1 per cent silicon.

The percentage of flux employed will be considerably less with the former iron. This is due to the fact that the iron carries off many pounds of silicon that in the latter

must be taken care of by the slag in the shape of silica.

As a rule slags high in alumina (exceeding 15 per cent) are undesirable. Silica may vary from 27 per cent to 37 per cent, depending upon the analyses of the ores and fuel, the volume of slag, and the grade and quality of iron desired.

Changes occur in the composition of slags, due to mechanical causes, requiring constant watchfulness and supervision as well as the variations in the ores, limestone and fuel.

Theoretical fluxing is one thing, but practical fluxing to obtain the most economical results, both as to product, quality of iron, fuel consumption, etc., is quite another thing.

It gives room for the display of no little individuality so far as the management is concerned, and considerable difference, when judged by the final test of all, viz., the balance sheet.

By experience we learn to distinguish slags by their physical appearance. Chemical analysis is too slow and not conclusive, for while indicating a safe slag, so far as the operation is concerned, it does not show the refinements that will suggest themselves to the experienced manager.

The most successful founders of the old school were good judges of slags, quickly observing slight changes and acting promptly, guided by these indications. The most successful managers of the new school acquired this expert knowledge by actual contact with the daily operations of the furnace.

It is in this particular, along with others of perhaps equal importance, only to be gained by an apprenticeship, long or short, depending upon the individual, that chemists, attempting to run a furnace on theory, made lamentable failures.

FUEL AND ORES

Up to 1882 anthracite coal was the exclusive furnace fuel east of the Allegheny Mountains, coke being used to the west.

The mechanical difficulties of blast furnace management are much greater with anthracite fuel and the magnetic ores, common to the east, than with coke and the easier working lake ores.

Indeed, the anthracite district has been a most valuable school, furnishing in the past some of the ablest and most successful managers for western furnaces.

Some years ago Mr. Chas. Foote, now vice-president of the Illinois Steel Co, wrote me that the use of Connellsville coke and Lake Superior ore in the blast furnace was heaven on earth to the manager accustomed to anthracite coal and the magnetic ores of New York and New Jersey. He had previously managed the Crown Point furnaces on Lake Champlain, and wrote feelingly, urging me to go West. I did not go West, though strongly tempted, but in the lapse of years cheaper transportation, etc., have brought Lake Superior ore and coke to eastern Pennsylvania, so that we are finding more comfort in living than we did some years ago.

Anthracite coal is dense and solid, consuming on the surface only, while coke is porous and light, the combustion permeating the whole structure. Much more coke can be burnt in the same space in the same time, thus increasing the product of the furnace.

Coke offers less resistance to the blast, permitting the use of a larger volume of air per minute with the same engine and boilers. Coal is generally higher in carbon and lower in ash and sulphur. Coal will carry and melt as many pounds of ore as coke.

The fuel consumption per ton of iron for long periods is less with coke for the reason that the furnace can be handled with greatet ease and with less danger of mechanical disturbances.

By reason of the more uniform working, the product of the furnace is larger, and the fuel consumed has a larger divisor.

Coal is apt to splinter and decrepitate upon exposure to heat and this tendency is one of the reasons why an anthracite furnace is difficult to control. The dirt thus formed in the furnace not only reduces the amount of combustible fuel reaching the tuyeres, but accumulates along the walls, giving rise to serious mechanical difficulties. Coal dirt, though nearly all carbon, will not burn in the furnace. It is carried off by the slag, sometimes in comparatively large quantities. As the slag flows down the runner from the tapping-hole or cinder notch, into the car provided to receive it, the dirt will separate. The slag being heavier, drops at a different angle, so that the dirt can be collected on a shovel.

When examined, the small particles show the same bright fracture and ofttimes the same bright surface as when mined, thus passing through the fiery furnace unscathed.

It would be an unspeakable blessing if all the coal dirt formed in the furnace was only thus carried off. Unfortunately this is not the case. Sometimes the obstruction caused by its accumulation so seriously impedes the passage of the blast that we are obliged to stop the engine, remove the tuyeres and ravel out the dirt through the tuyere openings, together with other stock, in order to secure passage for the blast and gases.

ORES.

Ores of the same oxidation, belonging to the same class chemically and of essentially the same analysis and physical structure, very greatly as to their working qualities and their practical value. One may part with its oxygen freely. Another may hold it very tenaciously. Why this is so I do not know, but it is a fact that influences the consumption of fuel per ton of iron more than the uninitiated would imagine. By burden is meant the pounds of ore that one pound of fuel will carry, that is, deoxidize and melt, converting it into pig iron. The burden is affected by this quality existing in ores, the difference between the burden at 1.5 lbs. of ore and 1.75 lbs., the grade of iron remaining the same, is ofttimes the difference between running at a commercial loss or a corresponding profit.

The burden is also affected by the richness of the ore mixture, for instance, notwithstanding the larger volume of slag, and, of course, the larger amount of flux usually used with a 50 per cent ore, the furnace will carry a larger burden of a 50 per cent ore mixture than if it was 60 per cent. This is due to the chemical duty to be performed in the way of deoxidation. With a burden of 1.50 lbs. ore yielding 50 per cent, the iron per pound of fuel is 0.75, while with a 60 per cent ore it is 0.90 lbs. iron per one pound of fuel. A correspondingly larger amount of oxygen is to be removed by the gases in the latter case.

Other things remaining the same, while the burden possible with a 60 per cent mixture is smaller than with a 50 per cent mixture, the fuel per ton of iron made will be less with the 60 per cent mixture.

Magnetic ores are usually very dense, and more or less difficult to handle, parting with oxygen slowly.

If ores are too finely divided physically they are a source of trouble. The gases, meeting more resistance in their ascent from the tuyeres, will seek the easiest way of escape. Channels of travel are apt to be formed, or, to speak technically, "the furnace becomes channeled." The effect is that portions of the furnace do not receive their share of the gas, and ore reaches the crucible holding oxygen in combination. This is destructive to the temperature of the crucible and represents a loss of fuel and waste of iron, to say nothing of the irregularities that will develop at and about the boshes, if the unequal distribution is not corrected.

It will be thus seen that good judgment, skill and experience of the manager in selecting and combining ores to accomplish a certain end plays a very important part, and figures largely in the final result, measured in dollars and cents.

Furnaces are not usually run for pleasure, nor for demonstrating any particular engineering device or the working out of any chemical theory, however attractive, but they are run for the sake of profit. Frequently, only too frequently, we are disappointed and sadly disappointed in results, but the man that combines technical knowledge with practical experience and an acquaintance with business conditions and requirements, with a due appreciation of their importance, is the man that will show the best final results and is the manager that is sought after. In the blast furnace business a little knowledge is very dangerous. The man, who in his own estimation knows it all, of course has no inducement to learn.

LIMESTONE.

The flux usually employed is either limestone, calcite or magnesium limestone, dolomite. Whether one or the other should be used depends upon circumstances, commercial and technical.

Either will answer, so far as mere running is concerned.

At the same cost per ton of stone, the use of calcite or dolomite will depend in great measure upon the composition of the ore mixture and the kind of iron to be made.

PIG IRON.

The various qualities of pig iron derive their names from the uses to which they are put or from their composition.

Bessemer iron is pig iron of suitable composition to make Bessemer steel.

Basic iron is pig iron suited for the basic open hearth steel manufacture.

Basic Bessemer for the Basic Bessemer converter.

Foundry iron for use in foundry to be remelted and cast into various forms.

Mill iron for use in puddling furnace to be converted into wrought iron.

Low phosphorus for use in acid open hearth steel manufacture and steel castings.

Spiegel, Ferro Manganese and Ferro Silicon are irons of particular composition, for special purposes, and require special ores and treatment in the blast furnace.

BLAST.

Furnaces are now operated by volume of air blown per minute as distinguished from the old practice of running by pressure of blast. Pressure is now regarded in the light of one of the valuable indications of internal working or conditions.

Calculated over long periods as measured by piston displacement and exclusive of wastage, between 5 and 6 tons of air are required to produce one ton of iron, and from 60 to 65 cubic feet of air to burn one pound of fuel, depending upon the tightness of pipes and fixtures and of the air piston of blowing engine. Atmospheric moisture plays an important part. It is never absent. It enters the tuyeres as vapor of water, calling for an increased amount of fuel to restore the heat absorbed by converting this vapor into its constituent parts, oxygen and hydrogen. Whether the air contains 5 grains moisture per cubic foot or 10 grains, either must be provided for by extra fuel or higher heat of blast, if the temperature of crucible is to be maintained. On an average for any one year, probably 125 pounds of water per ton of iron will be forced into the tuyeres in the shape of vapor, while during the humid summer months it may amount to 200 pounds and over.

This is the reason why more fuel per ton of iron is required during the summer as compared with the winter months.

As a rule less cubic feet of air is required per minute to consume the same amount of fuel during the fall, winter and spring months than during the warm months of the year.

BLAST FURNACE MANAGEMENT.

The modern blast furnace is not an invention, nor a discovery, but a growth. It represents the combined results of numerous experiences, and in itself is the epitome of many a hard-won fight. Sleepless energy and untiring devotion, perseverance in overcoming obstacles apparently unsurmountable, and the forgetting of self, has worked out many unsolved problems. Blast furnace management is fearful drudgery for a man not in love with his work.

No department of iron or steel manufacture calls for closer application and attention to details. It is absolutely continuous. With these qualities lacking, no amount of technical knowledge will win success. The most successful managers have been those that were so absorbed in their work that they never stopped to inquire whether they were being suitably paid.

The results obtained have shown that capital usually seeks out the best talent.

Time does not permit to more than merely mention a few of the improvements. The hearth with open foreheart hand tympe gave place to the German patented, closed front. The principle, however, was worked out in American practice, we finally adopting a modified form of the Lurman device. Firebrick stoves, an English invention, have practically replaced the cast-iron pipe stoves for heating the blast. Enthusiastic agents, eager to swell their commissions, made extravagant claims for super-heated blast, in fact representing that brick stoves were really a panacea for all blast-furnace ills.

They have proven a valuable anjunct, but many failures and serious troubles, scaffolds, etc., followed their introduction in many instances. Numerous minor but important improvements have been made in tuyeres and tuyere fixtures, etc., permitting the replacing of tuyeres in 5 to 10 instead of 30 to 40 minutes.

We have replaced tuyeres with only stoppages of two to three minutes.

This may be considered incredible by many furnace managers. We now use mechanical appliances for stopping the iron-tapping hole, an invention of Samuel W. Vaughan, manager of the Cambria Iron Co.'s furnaces, thus saving many long stoppages. When a furnace is making iron at the rate of 8 to 10 tons per hour or more, the importance of every minute saved in stoppages can be appreciated.

One of the most frequent and troublesome of the mechanical difficulties is the formation of "scaffolds" in the furnace.

A scaffold is an accumulation on the walls of the furnace, offering an obstruction to the regular and even descent of the material and diverting the uniform distribution of the gases.

Scaffold material is an agglomeration of coal or coke, limestone and ore, partially

fused into a solid mass and fastened to the walls. Sometimes scaffolds form a short distance above the tuyeres and gradually grow, extending far up into the shaft of the furnace. At others they commence at the top of the boshes, beyond the reach of the tuyeres, extending upwards and towards the center of the furnace. Not unfrequently the area of the furnace is so compietely occupied by this solid mass that only a small opening, a few feet in diameter is left free from top to bottom.

Of course the operations of the furnace are brought to an inglorious close, but usually only after a hard and laborious fight—a very expensive contest.

On other occasions the obstructions cause irregular working, inferior iron and high-fuel consumption, with excessive costs, but may not be sufficiently serious to put the furnace out of blast. As a rule, however, it does not pay to fight a serious melted scaffold in the hopes of restoring the furnace to good working condition. It may appeal to the professional pride of a manager to continue the fight, but as a commercial proposition it is usually cheaper to stop, shovel out and try again. Scaffolds are not as frequent as formerly, but they are still a serious menace and in one form or another are a constant source of danger and anxiety.

It is estimated that fully 70 per cent of the heat of the crucible is brought into it by the solid materials which in their descent through the furnace come in contact with the highly-heated gas currents.

The effect of any serious interruption to the regular descent of this stock can be thus appreciated. The working or acting area of the furnace being thus reduced by the scaffold accumulation, the flow of gases is confined to a restricted channel. The time of contact with the ores is lessened so that they reach the crucible unprepared for melting, which further lowers the temperature of the crucible. The blast meets with greater resistance, and at times the whole power of the engine fails to drive the air through the furnace. The flow of gas failing, the hot-blast stoves are thus deprived of their source of heat, and the temperature of the blast falls. The boilers are fired with coal to maintain steam to operate pumps and keep the engine moving. Finally a passage may be opened and gas again flows through the stoves as the blast finally works its way through the obstruction.

With the lowering of the temperature of the crucible the tuyeres are closed with a semi-fluid mass of iron and slag, communication between the tuyeres and cinder notch or slag opening and the iron tapping hole is obstructed by the partial chilling of the contents of the crucible. Days and sometimes weeks elapse before any iron of merchantable shape and quality is run into the pig beds.

My first experience of a genuine scaffold of the worst kind was a few months after I was entrusted with the responsibility of the management. During an absence of a few days my foreman filled into the furnace a lot of dirty limestone. The limestone shipments had been delayed by wet weather. The center of the stock pile was reached, which proved to be very dirty from long continued dumping and the daily removal of clean stone from the edge of the pile. For two weeks I never saw a bed. The struggle lasted a month or more. Finally the furnace was restored to normal working condition, much to my gratification, but at great expense and loss to the company. I was thus early impressed with the importance of exercising the most careful watchfulness as to the preparation of the material filled into the furnace—ores, fuel and limestone.

It was a valuable though costly lesson, and I have since tried to make good use of it. It pays to use every precaution to prepare the stock before filling, rather than throw additional work on the furnace and run the risks of serious disturbance of its operations.

By experience we learn the various symptoms characteristic of disorders or variations from normal conditions, just as physicians determine disease.

The correct diagnosis is more or less difficult and obscure, as different causes produce the same results. It is just as easy for the furnace manager to draw wrong conclusions and administer the wrong remedy as for the doctor, though he may have the more or less intelligent assistance of his patient.

In the meantime the patient in both cases suffers the penalty of ignorance, however excusable that ignorance may be on the part of the attending expert.

Serious difficulties command the attention of even the average workmen. They mean hard work all around. In many instances less than one-half of the labor neces-

sary to overcome troubles would have prevented them altogether if the warnings had been observed—in other words, if the symptoms had been detected by close application and attention to details. I have always endeavored to impress this fact upon my foremen, by precept and example.

When the furnace is running along smoothly then is the time for the manager to be watchful, to give attention to minute matters and thus endeavor to keep her running regularly.

The average man, under such conditions, is apt to become careless and neglectful. He fails to observe indications of importance, not purposely, but simply from lack of intelligent observation.

Seeing, he sees not, that is, he does not perceive; the mind is dormant. Constant watchfulness and preparation for difficulties that may never come is no more an evidence of undue nervousness than a laudable ambition to improve one's condition is to be confounded with restless discontent, so disastrous to all effort.

The formation of scaffolds is due to many causes, and sometimes they apparently come from no traceable cause, simply from "pure cussedness."

Scaffolds may result from the furnace being too hot, as well as too cold; from errors of fluxing or variations in materials (theory may be all right but practice all wrong); from improper filling of stock, either from badly proportioned bell, neglect in the stock house or on the part of the top filler; from long continued use of excessively basic slag, lime scaffolds may be formed, or from use of slags too silicious.

Unexpected stoppages, due to accidents, allowing no time for preparation, may or may not be followed by scaffolds more or less serious.

The gangue of certain ores, fusing to a sticky mass at comparatively low temperature or the use of an easily clinkering coal, may be responsible. A hard and tough white ash coal is required for blast furnaces.

Volume of air blown, area of tuyeres and heat of blast, under certain conditions, are frequently important factors.

Time will not permit any reference to remedies employed to dislodge and remove scaffolds other than to remark that they are sometimes heroic, involving the liberal use of dynamite or practically blowing out or lowering stock below the scaffold, thus loosening it by melting away the foundation and then refilling.

Methods will vary with circumstances and the judgment of manager.

Other disturbances to uniform settling of the stock are known as "arching," "hanging," and "jumping." These invariably produce bad results. If continued, they add to the cost of the iron and at the same time cause the production of lower grades and inferior quality. They are not necessarily dangerous.

If not corrected, however, the conditions producing them may lead to a permanent melted scaffold. They may be considered as warnings of something worse to follow.

Accumulations may form on the bosh walls of considerable thickness that in no way interferes with the uniform working of the furnace. If these accumulations are evenly and regularly distributed they serve to protect the brickwork from fusing and from the destructive chemical action of the slag and gases.

This coating at times forms an artificial bosh, more durable than the original brickwork, in fact a graphitic lining.

Furnace "kish" corresponds closely in composition with native graphite, from which plumbago crucibles are manufactured.

Artificial graphite contains more iron than the native, as the following analysis will show:

	Fe. %	Si2. %	C. %
Native graphite.....	1.6 to 4.6	2.4 to 8.6	78 to 85
Artificial or furnace graphite	17.3	2.20	70.74

When two or three tons of fuel were consumed per ton of iron, or when comparatively large furnaces made but small products, the artificial, or furnace-made bosh lining served to lengthen the duration of the blast. Modern practice, however, does not rely upon this formation to protect the bosh walls, finding it inconsistent with fuel economy and large products.

MODERN CONSTRUCTION.

With more intelligent management the common construction previous to 1880 was found inefficient. The changes were gradual, experimental, groping in the dark, as it were.

Each change was made to overcome some special difficulty, as the necessity presented. Probably this side of the subject can be best illustrated by giving a short sketch of the operations of the Warwick furnace. This furnace was first started in 1875.

From 1875 to the summer of 1877 it was in charge of experienced founders, of good reputation, but one scaffold followed another, varied by chilling, about every six months, so that the company was brought to the verge of bankruptcy. The causes were various, but chiefly to the lack of knowledge of the material used.

The ores used and mined by the company were of different composition from those usually employed in the Schuylkill Valley at that time. The largest product of iron for any one week was 190 tons, which represented the average best work of furnaces of the same size in the vicinity. The weekly average, however, of any one blast barely exceeded 50 tons per week for the reasons mentioned.

November, 1877, the furnace was placed in my charge. No changes in construction were made except the substitution of a 7-foot bell in the place of a 5-foot bell. In blowing in, the furnace started excessively hot, causing me much anxiety, but it proved a blessing in disguise, as was demonstrated a couple of years later.

A graphitic coating was formed on boshes, or a scaffold evenly distributed, preserving the brick work without interfering with the working of the furnace. The bosh walls following the construction of that period, were about 3½ feet thick.

In the course of a few weeks the furnace reached a weekly make of 300 tons and over, an unheard-of product at that time for an anthracite furnace of its size.

It created more local excitement and interest than a make of 1,300 tons does now. When congratulated I replied that I was sorry, as I was afraid that a standard had been made that could not be reached again. We ran 105 weeks without special incident when the inwall gave way, terminating the blast.

The average weekly product was 357 tons.

The furnace was relined, maintaining the same construction, and blown in March, 1880. My troubles now commenced, 1880 being an eventful year. It was a life and death struggle, not only for me, but the new method of management was on trial also.

I had earned the jealous hatred of the old school and my troubles were a source of no little satisfaction to many.

Furnace was blown in March 28, 1880, care being taken not to allow the furnace to start so hot, or grey as it is termed, as the previous blast. A good start was made, the product averaging 368 tons per week, but we only ran six weeks. A new furnace disease was developed, symptoms were not wanting, but their significance was not appreciated until some months later. No serious irregularities were experienced, until upon a certain night following an unusually large cast, the stock settled a few feet from the top, a common occurrence. Following each cast a stoppage was then necessary to close the iron tapping hole. On starting engine it was found that the resistance to blast entering tuyeres was so great that the engine was barely able to run. Gas failed, steam became short, necessitating heavy firing. The tuyeres became a dull red, showing partially fused iron and slag.

Melting practically ceased. Communication between tuyeres-cinder notch and iron notch was cut off. With 14 pounds pressure at the tuyeres, scarcely any flame was perceptible at the open iron or cinder hole. Some of the tuyeres became solid; others melted slowly. The liquid, not being able to sink into crucible, formed a column of sufficient weight to overbalance the air pressure of slag and iron.

After struggling day and night for several turns I was forced to admit that the furnace was chilled. We proceeded at once to empty the furnace. In cleaning out, it was noticed that from the tuyeres upwards for a distance of ten feet or more the contents were a mass of finely divided dirt, analyzing 47 per cent coal, 46 per cent ore, 7 per cent limestone. Above this mass of dirt the stock was in good condition. Below the tuyeres the crucible was filled with dirt, offering no difficulty to remove.

There was no iron to contend with.

When furnace was finally emptied, measurements were taken, showing the inwall above boshes to be in good condition and of about the same dimensions as when blown in, but the bosh walls were completely melted, only a light shell on the outer course remaining, about 9 inches thick instead of 42 inches.

It was assumed that the brick used were of poor quality, but this explanation, while the best that could be given at the time, was not satisfactory to me, nor probably to any one else.

There was no evidence of a melted scaffold such as previously described, and "dirt scaffolds or dirt troubles" had not then received a name. During this short blast we

made mill iron, and my critics asserted that I was running for sake of a record without regard to the durability of the furnace and that no furnace could stand such treatment.

Repairs were made, a new bosh with different make of brick being constructed. The furnace was again blown in August 27, 1880.

This time I aimed to make foundry iron to meet the criticisms mentioned. It was generally understood that foundry iron formed graphitic protections to the bricks and to this extent prolonged their service. This was undoubtedly true when combined with large fuel consumption and small product, but fortunately or unforunately for me our product of foundry iron averaged 382 tons per week, a larger weekly product than had yet been reached.

In nine short weeks we had a repetition of the previous blast almost exactly. In the midst of the best working and largest yield, with scarcely any warning, the furnace was again chilled.

Precisely the same conditions were found to exist as before, only more so. The loss of brick work extended higher up the boshes, the mass of dirt being proportionately greater.

To say that I was discouraged does not begin to portray my feelings, but I was determined to kill or cure. In cutting away the brick work below the mantle, in order to make an opening to remove the stock, I noticed that as soon as the workmen penetrated and air was drawn in through a small hole, cinder commenced to trickle down. As the opening was enlarged, the stock was shown to be white hot and in good condition. It then occurred to me that the whole trouble was due to the dirt, and if the dirt had been removed through the tuyeres by ravelling out we would have been saved much hot and hard work and the furnace might have continued in blast. At the time, however, it was too late.

(To be Continued.)

Something About Cupolas.

The S. Obermayer Co., Cincinnati, O., and Chicago, Ill., in addition to its immense business in general foundry supplies, also sells cupolas. It goes without saying that a firm of such high standing as the Obermayer Company enjoys would not act as agent for anything short of first-class goods in any line, and the fact that they are selling the Whiting cupolas, cranes, ladles, etc., is a sufficient attestation to the high standard of excellence in these equipments. The popularity of the Whiting cupola may be inferred from reading the following list of recent sales:

Webster M'f'g Co., Chicago, one No. 7.
Indianapolis Foundry Co., Indianapolis, Ind., one No. 5.
C. H. Dutton Co., Kalamazoo, Mich., one No. 3½.
Moser, Wehrle & Co., Newark, O., one No. 7.
National Sewing Machine Co., Belvidere, Ill., one No. 5.
Deere & Mansur Co., Moline, Ill., one No. 3.
University of Nebraska, Lincoln, Neb., one No. 1.
New Albany M'f'g Co., New Albany, Ind., one No. 4.
F. B. Fargo & Co., Lake Mills, Wis., one No. 3.
Milwaukee Harvester Co., Milwaukee, Wis., one No. 8.

J. W. Paxson Co.'s Catalogue No. 10.

This is one of the most complete, convenient and interesting catalogues we have ever seen. Its size is 4"x 6", and it has 260 pages of information artistically, and therefore, interestingly presented. The first page (or frontispiece) presents a trio of grinning little "coons," who "look alike to me," except for the dress of the one on the left being a facing sack, marked "Lehigh Pipe Blacking;" the one in the middle is marked "Seacoal Facing, J. W. Paxson Co.," while the one on the right bears the words "Car Wheel Mineral Facing."

Pages 2 and 3 contain pertinent general remarks and facts concerning their business, one important fact being that the J. W. Paxson Co. has had 35 years of experience in the supply business. Then come five pages enumerating the different kinds of facings and prices per lb. They illustrate foundry facilities and supplies of every kind, from a chaplet to a Paxson-Colliau cupola. They also supply everything needed in both brass and steel foundries. Millett's patent core oven is well illustrated in four excellent cuts. There are also excellent illustrations of various molding machines, presses, stripping plates, etc.; also Groves' Universal Patent gear molding machine. There are sand and clay crushers, mixers and sifters, tumbling mills galore. For the pattern-maker, there are illustrations of Universal Trimmers and Band saws, with samples of work done upon them. They show pattern

makers' benches, pattern letters, clamps of various styles, snap flasks, brassmakers' flasks, and all kinds of molders' tools.

In the back part of the book are tables of information of great general value to all foundrymen, such as: Areas of circles—diameter of blast pipes for various sized cupolas—melting points, weight per cubic foot, weight per cubic inch, tensile strength and specific gravity of metals, etc., etc.

Last comes the index, which enables you to find just what you want without loss of time and the foundryman who can't find what he wants for his business in these 260 pages will please report to Howard Evans at the convention of the American Foundrymen's Association at Pittsburg, next summer.

William T. Shepard, for the past three and a half years secretary of the Sessions Foundry Co., of Bristol, Conn., has resigned his position to accept that of secretary of the Tonawanda Iron & Steel Co., of North Tonawanda, N. Y. George M. Eggleston, who has been connected with the Sessions Foundry Co. for a number of years, has been elected secretary of that company.

NOTICE!

Advertisements in this column, 30 cents a line for each insertion About seven words make a line. The Cash and Copy should be sent to reach us not later than the 20th to insure publication.

Answers addressed to our care will be forwarded.

TO SUBSCRIBERS

whose names appear on our **subscription** list, we will give one free insertion under this heading to those in want of positions, the advertisement to occupy a space of not more than five lines. Additional space or insertions must be paid for in advance at regular rates.

WANTED—Good molders. Address Kimball Bros., Council Bluffs, Iowa.

WANTED—Position as melter in a Western foundry. Twenty years' experience. Good references. Address, Box 161, care THE FOUNDRY.

WANTED—A foundry foreman; one who is competent to handle help, and is familiar with molding, mixing metals, etc. Address, stating age, experience, etc., Box 167, care THE FOUNDRY.

WANTED—Position by a foundry foreman, accustomed to all kinds dry and green sand work; experienced in mixing iron and handling men. Best of references. Address, Box 165, care THE FOUNDRY.

FOUNDRY FOREMAN—A bright young man, 31 years old, pattern-maker and molder, would like to take charge of foundry employing molding machines. Capable of laying out work and superintending same. Address, "Machine," Box 158, care THE FOUNDRY.

WANTED—Position as foundry foreman. Able to produce light and heavy castings up to 40 tons. Experienced in handling men, mixing and melting iron, and up-to-date practice in general. Temperate and reliable. Address, "Position," Box 154, care THE FOUNDRY.

WANTED—Foreman for jobbing brass foundry. Must be up-to-date in methods, and be able to handle large and small castings. Also practical metal mixer and good judge of heat. One familiar with boat work preferred. Address, Wideawake, Box 166, care THE FOUNDRY.

WANTED—Foreman for core department, who thoroughly understands making of large and small cores, mixing of sand, etc. Competent to take charge of core-room employing twenty coremakers. References required. Address, Core-Room, Box 161, care THE FOUNDRY.

WANTED—Situation as foundry foreman; have had fifteen years' experience on both light and heavy castings, and can come well recommended. Understand mixing and melting of iron and can make estimates on all classes of work. Address, Box 162, care THE FOUNDRY.

WANTED—A metallurgist who has been eminently successful in thorough laboratory work and in its practical application in iron foundry practice, desires permanent position. Chilled, soft and specialty castings to specifications with economy. Laboratory for sale to employers. Reports and improvements at reasonable rates. Address, Box 163, care THE FOUNDRY.

WANTED—Position as superintendent or manager of a foundry. Have had large experience in loam, dry and green sand, and thoroughly understands machine molding and mixing and melting of iron. Am at present employed by one of the largest firms in the country. Best of references and satisfactory reasons given for making the change. Address, Manager, Box 164, care THE FOUNDRY.

FOR SALE—A foundry and machine shop, situated in Phillipsburg, N. J., on the banks of the Delaware River, directly opposite the city of Easton. Business established in 1872; capacity of foundry, 8 tons per day; machine shop equipped with modern tools and patterns; lot fronts on Pennsylvania R. R., 180x264 feet deep; shop makes a specialty of manufacturing the Telegraph Fodder Cutter. Address, Vulcan Iron Works, Phillipsburg, N. J.